The Politics of Open Source

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Letter from the Conference co-Chairs

Welcome to the University of Massachusetts (UMass) Amherst and the 2nd Annual *Journal of Information Technology & Politics* thematic conference, "Politics of Open Source."

We wish to thank the Program Committee for their hard work in putting together a truly exciting program that highlights the vast diversity of research being conducted on open source software and the FLOSS movement.

The conference is generously supported by Microsoft and Google. We also wish to acknowledge the financial support of Andy Barto and the UMass Amherst Department of Computer Science, John Hird and the UMass Amherst Department of Political Science, and the Texifter LLC. We have additionally received support from the Center for Public Policy and Administration at UMass Amherst, *the Journal of Information Technology & Politics*, the Qualitative Data Analysis Program, the National Center for Digital Government, and the Open Source Software Institute. As always, any opinions, findings, conclusions or recommendations here are those of the author(s) and do not necessarily reflect the views of the sponsors.

Again, welcome to UMass, and enjoy the conference!

Sincerely,

Stuart Shulman & Charles Schweik
Conference Co-Chairs

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What Can Wikipedia Tell Us about Open Source Politics?

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Abstract

This paper considers the emergence of large-scale "commons-based peer production" projects such as Wikipedia.org from an institutional development perspective in order to comment on the potential and limitations of so-called "open source politics." The argument it makes is threefold. First, that that the lowered transaction costs and information abundance found online transform a subset of public goods problems, essentially replacing free ridership with mass coordination as a central challenge. Second, that the boundaries of this subset are defined by a "power law topology" and by existing "interest horizons." These parameters limit the overall impact of commons-based peer production for the political space. Third, that all such hubs move through a common five-stage institutional development process, directly related to standard models of the diffusion of innovation. The paper concludes by deriving a set of hypotheses regarding the circumstances under which commons-based peer production is likely to be successfully applied to political action.

Keywords: Web 2.0, open source politics, diffusion of innovations, user-generated content

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Introduction

"*Imagine a world in which every single person on the planet is given free access to the sum of all human knowledge. That's what we're doing*." – Jimmy Wales, founder of Wikipedia

The rise of "commons-based peer production," first in the field of open source software development and recently spreading to a diverse array of fields, has produced wide hopes for the emergence of "open source politics." No consensus definition exists for the term, but it generally represents an amalgamation of hopes and dreams for social transformation from political commentators, consultants, futurists, and open source software practitioners. If clusters of volunteer software developers can group together online and peer-produce a successful challenge to corporate giants like Microsoft, couldn't citizens likewise group together to mobilize for large-scale political change? Such hopes run inevitably into the challenges of collective action that have long been the purview of political scientists. Has collective action fundamentally been changed by the novel communication patterns found online? If so, just how far do these changes extend?

The purpose of this paper is to use one such peer-produce community – Wikipedia.org – to derive a set of hypotheses that can be broadly applied to the study of "open source politics." While the literature on Free/Libre and Open Source Software (FL/OSS) and related practices of commons-based peer production has undergone significant advances in recent years (see Weber, 2004; Benkler, 2006; Zittrain, 2008; and Kelty, 2008 to name just a few), research on open source politics continues to face substantial conceptual hurdles. Open Source software is characterized by the open accessibility of source code, and is clouded by popular misconceptions about the resultant production process. Open Source politics has no direct equivalent to source code (faulty software code fails to compile, faulty political strategy has no such equivalent), and thus it mostly refers to "bottom-up" or "transparent" political practices –themselves often based in cloudy misconceptions of open source production. This presents several conceptual issues, not the least of which is defining testworthy hypotheses and identifying the set of institutions appropriately dubbed "open source" in the political arena. What is the general pattern that such participatory communities follow in their formation? Where are they likely to develop, and where should their spread be limited?

The paper is intended as a theory-building exercise. It draws heavily upon the robust literature on Wikipedia, most notably Andrew Lih's *The Wikipedia Revolution*, Jonathan Zittrain's *The Future of the Internet (And How to Stop It)*, and Clay Shirky's *Here Comes Everybody*, to derive a set of hypotheses about participatory community-formation in other fields. In so doing, it also summarizes several of the core distinctions between the online communications environment and previous communications regimes, particularly with regards to the challenges facing collective action. In a similar vein as classic works like "The Iron Cage Revisited" (DiMaggio & Powell, 1983), the paper ends with hypotheses, rather than beginning with them. The goal here is to sketch a set of testable theoretical propositions which can potentially illuminate the scope and substance of the heretofore ill-defined field of "open source politics."

Why Should Students of Politics Study Wikipedia?

Wikipedia, "the encyclopedia that anyone can edit," is a public good, both in definition and in spirit. It clearly meets the classical definition of public goods, being both nonrival (my use of Wikipedia does not reduce your ability to use it) and nonexclusive (all people can access Wikipedia, regardless of whether they contributed to it). Perhaps more importantly, it is animated by a set of decision-makers and participants who self-consciously develop it as a free, abundant public resource. Founded in 2001, Wikipedia has grown from curious social experiment to the 6th most-visited site on the entire web, receiving more unique visitors per day than the websites of the *New York Times*, *LA Times*, *Wall Street Journal*, MSNBC.com, and the *Chicago Tribune* combined. In this success there lies a significant puzzle for social scientists. For at least the past 40 years, since the publication of Mancur Olson's *The Logic of Collective Action*, we have known with relative certainty that public goods suffer from the "free rider" problem and, except where this free rider problem is overcome, are underprovided to society. Public goods in a free market are almost by definition underprovided. With over 10 million articles across 200 languages, Wikipedia has been subject to plenty of critiques, but "there just isn't enough of it," has never been among them.

Though not a *political* endeavor itself, the case example of Wikipedia illustrates a number of core concepts regarding the structure and novel attributes of web-based communication protocols, and of the online communities that such communication has enabled. As such, it is of great interest to the scholarly debate on "open source politics." The following section will use Wikipedia to demonstrate how the condition of *information abundance* found online replaces the traditional problem of free ridership with an ascendent mass coordination puzzle. The problem of mass coordination is solved through the development of a *power law topology* in which large hub spaces let communities-of-interest engage in collaborative efforts that would have been impossible under previous information regimes. Novel solutions to the collective action problem, and novel structures for collective action, become possible online because of these changes to the costs, abundance, and availability of information. The emerging landscape of collective action fundamentally departs from previous eras in direct relation to the salience of these attributes, and Wikipedia serves as a guiding example for understanding them.

Much of what makes Wikipedia worthy of analysis is the sheer scale of its success. The only websites more frequently-visited than Wikipedia are the search engines/email providers Google, Yahoo, Windows Live/MSN, video sharing site YouTube.com, and social networking site Facebook.com. Unlike these for-profit internet giants (YouTube being a subsidiary of Google), Wikipedia operates with a budget of less than $500,000 and a staff of fewer than a dozen employees (Lih, 2009. Pg 4). A core of 75,000 active volunteer "Wikipedians," along with 9.5 million registered users and an untold number of anonymous users contribute the bulk of content, citations, and edits. Despite providing little opportunity for fame or recognition to the volunteers, this expanding volunteer corps has remained resilient against attempts to subvert the site through vandalism or thinly-veiled advertising. A 2007 study by the Pew Internet and American Life Project found that 36% of American adult Internet users consult Wikipedia. It is especially popular amongst the well-educated, with 50% of all online Americans who hold a college degree using it as a reference. On a typical day, 8% of online Americans consult Wikipedia, making it more popular than online purchasing, dating websites, setting travel reservations, using chat rooms, and participating in online auctions. (Rainie and Tancer, 2007) This raises the practical question of whether Wikipedia is now so distinct as to be something different, something greater, than an encyclopedia. Consider the following: in the pre-Internet era, what percent of Americans would we suspect consulted an encyclopedia on an average day? Is it likely that looking things up in the Encyclopedia Brittanica has ever been more popular in daily life than purchasing goods or trying to find a date?

Wikipedia's ascendant growth has made it a standard example among the cross-disciplinary community interested on the internet's impact on the economy, society, culture, media, and politics. Yochai Benkler treats it as an example of "commons-based peer production" in his 2006 *Wealth of Networks*, arguing that the lowered transaction costs of the internet allow for the development of a networked information economy in which volunteer-based production can compete with and even outperform firm-based production (Benkler, 2006). Clay Shirky offers the site as a prime example of "organizing without organizations" in his 2008 *Here Comes Everybody*. (Shirky, 2008) Axel Bruns suggests that production in these web spaces is so distinctive as to require a new term: "produsage" rather than "production." (Bruns, 2008) Jonathan Zittrain uses it as a prime example of the principle of "generativity" in *The Future of the Internet – and How to Stop It* (Zittrain, 2008), while David Weinberger uses it to animate his discussion of changing search protocols in *Everything is Miscellaneous* (Weinberger, 2007). The site is more than just an easy example for such authors. As the most mature example of these voluntary online participatory communities, it provides important insights into the possibilities and limitations of other such communities as they move from small-scale to large.

Political scientists have paid less attention to Wikipedia per se, but they have begun to look into the more generic impacts of the internet's lowered communication costs on online collective action. Arthur Lupia and Gisela Sin (2003) argue that Mancur Olson's work is "built from historically uncontroversial assumptions about interpersonal communication. Today, evolving technologies are changing communication dynamics in ways that invalidate some of these once uncontroversial assumptions." They go on to present a formal model that suggests the organizational advantage held by small groups in Olson's day is muted by online communication, while the selective benefits that many groups were once able to offer as an incentive for participation are occasionally undermined by the open access of the web (disciplinary journals, for instance, now face open-access, free web-based competition). Bruce Bimber, Andrew Flanagin and Cynthia Stohl (2005) likewise attempt to reconceptualize collective action as a phenomenon of "boundary crossing" between public and private domains, an indication of how near-costless participation in online petitions and other web-based pressure tactics has become.

For students of politics, Wikipedia ought to be considered as a central puzzle regarding the mediating effects of new communications media on collective action and other public goods. Why does commons-based peer production like this occur, and how broad are the applications likely to be? Will the practices and architectures of open source software "port" seamlessly into the public sphere of political action, and what are the circumstances under which such activity is likely to occur? As the largest and most notable example of commons-based peer production among citizens who do not themselves write software code, Wikipedia provides an ideal venue for generating hypotheses about the application of open source production processes to the political arena.

The next section will use the Wikipedia example to synthesize several core concepts regarding internet-mediated communication. Centrally, it will demonstrate that the structure of the web supports the development of large-scale communities that, benefiting from strong "network effects," can produce tremendous public goods on the basis of surplus labor contributions from hobbyists and partisans. When the costs of participation approach zero, a more complete demand curve for political engagement is revealed. In so doing, the section seeks to separate much of the marketing hype surrounding open source production from what has actually been learned about the production process itself. This will lead into a second section describing the growth of "network-enhanced goods" like Wikipedia along a five-stage process linked to standard adopter classes in the diffusion-of-innovations literature (Rogers 2003, Von Hippel 2005), paying particular attention to the institutional development challenges present at each stage. A third section then derives a set of hypotheses regarding the stability of *power law hubs* over time, and the conclusion then makes several points about the political implications of these hypotheses.

The Success of Wikipedia: Easy, Fun, and Full of Network Effects

Wikipedia was founded in 2001 after Nupedia, an attempt at producing an online encyclopedia based on traditional expert-produced and –reviewed contributions, failed to gather momentum. Jimmy Wales had launched Nupedia as an open-access competitor to pricey encyclopedias like *Britannica*. His expectation was that the speed and ease of email communication could lower the costs of producing a high-quality encyclopedia, making the information free for all visitors.[1] Nupedia was to be expert-led, with a traditional (and daunting) seven-stage peer-review and editing process. What Wales and his collaborator Larry Sanger learned was that the increased speed of e-mail alone does little to transform production processes. The hefty editing process resulted in numerous bottlenecks, leading to an estimated 25 articles in its first three years. As academic journal editors have likewise learned, moving from the fax, phone, and mail systems to digital communication alleviates *some* elements of peer review and content production, but the overall savings prove marginal. In attempting to radically simplify the production process, Wales and Sanger turned to the "wiki" (from the Hawaiian word "wikiwiki," translating directly to "fast" or "speedy") software platform. Wiki software code enables open content creation and peer editing. Any user with access (and on Wikipedia, most articles are accessible by all) can click an "edit this" button, make changes to the document, and have those changes instantly available to other users. Past versions are automatically archived and viewable, making such experimentation a low-risk affair.

Developer Larry Sanger wrote a memo to the two-thousand member Nupedia mailing list at

[1] Nupedia, unlike Wikipedia, was designed as a for-profit venture of Wales's company, Bomis.com. While entries were to be free, the site was intended to generate revenue through ad sales. Wikipedia was eventually launched as a separate nonprofit after a controversy among volunteer "wikipedians" over whether the company would one day profit from their free labor.

the launch of the wiki-based site, saying, "Humor me. Go there and add a little article. It will take all of five or ten minutes." (Shirky, pg 113) With the bottlenecks eliminated, over 1,000 articles were written within a month, and 10,000 were written within nine months. Clay Shirky describes this as a general shift enabled by the internet-based information regime: from "filter, then publish," to "publish, then filter." (Shirky, chapter 4) Print-based publication is costly and (thus) scarce. Firms are necessary to provide editorial and quality-control decisions at the front end, ensuring that the final product is well-written and attractive to a paying audience. Comparatively, Shirky notes that web-based publication is "ridiculously easy." Indeed, ever-expanding transistor capacity and server space render the web an abundant information environment where point-to-point communication (e-mail) can happen near instantaneously and self-publication is free. Wikipedia could not exist without internet-mediated communication, and moreover it could only exist through the embrace of novel alternatives to traditional production practices. Faster and cheaper communications media alone produce little change, but they create the possibility for novel structures for mass collaboration and collective action.

The *ease* of publishing online may be self-evident, but that is a far cry from assuring high-quality encyclopedia entries. Indeed, Wikipedia's quick rise in popularity was accompanied by an avalanche of skepticism regarding the quality of the new-entrant encyclopedia. The basic criticism could be summarized as, "Wikipedia is free, and worth every penny." Jim Giles published a 2005 study in *Nature* magazine challenging this claim through a comparison of Wikipedia and the *Enclopedia Britannica.* Peer reviewers recruited by *Nature* found an average of 4 inaccuracies per Wikipedia article, and 3 per equivalent *Britannica* articles (Giles, 2005). This led to a back-and-forth firestorm, with *Britannica* staff criticizing the study and demanding a retraction. *Nature* offered a clarification of its methodology, but stood by the study and refused to retract it. Physicist Bernardo Huberman has since conducted his own research on Wikipedia articles, finding a strong correlation between the number of edits a Wikipedia article receives and the accuracy and writing quality of the article (Huberman 2007). Put another way, the more contributors a Wikipedia article receives, the higher its accuracy and the better the writing. This is not entirely intuitive – certainly, anonymous visitors can and do engage in "graffiti" attempts on Wikipedia pages, and motivated partisans attempt to distort pages to favor their point of view. The site has developed both a set of community norms and practical computer code that lead contributions to have a net-positive effect.

Jonathan Zittrain, the co-founder of Harvard's Berkman Center for Internet and Society, traces the success of Wikipedia to three key attributes. The first is what he colorfully terms "verkeersbordvrij," from an unusual and surprisingly successful experiment in traffic management in the Dutch city of Drachten (Zittrain, pps 127-130). Drachten has done away with traffic signs, parking meters, and parking spaces, instead setting a few minimalistic traffic rules and asking citizens to mindfully operate their cars when interacting with one another. Likewise, Wikipedia began with a bare set of basic rules – (1) articles should display a neutral point of view (NPOV), (2) no copyright infringement, and (3) ignore any rules if they get in the way of building a great encyclopedia– and relied on the Wikipedia community to mindfully work them out, developing additional rules and protocols as needed.[2] As Jimmy

[2] Today, the three rules have been expanded to "five pillars:" (1) Wikipedia is an encyclopedia. (2) Wikipedia

Wales has remarked, "Generally we find most people out there on the Internet are good. It's one of the wonderful humanitarian discoveries in Wikipedia, that most people only want to help us build this free nonprofit charitable resource."[3] Additional rules have been added over time to manage controversies and improve site quality, but these principles remain at its core. The wiki software code and abundant server space are necessary conditions for this organizing structure. The code lets any community member or passerby offer positive contributions, small or large, while saving past versions for easy review. Graffiti attempts or biased contributions to an article can thus be removed from the page with a simple click of the "revert to past draft" button. "Bias" and "neutrality" are, of course, terms of art rather than an exact science, but the second attribute helps the community to approximate neutrality rather effectively.

The second attribute is the inclusion of a "discussion page" alongside every main Wikipedia page. This is a space for Wikipedians to explain and justify their changes, discuss article quality, and engage in deliberation and disagreement over controversial topics without cluttering the main page. Major edits made without explanation and justification are likely to be reverted, providing an incentive for thoughtful, deliberative engagement. Given the participation of hobbyist communities, many heated "flame war" exchanges occur over topics that are obscure to the mainstream, but passionately debated within a community-of-interest. This is an example of what Lawrence Lessig terms "Code-based governance." (Lessig 1999) Within cyberspace, many of the decisions about how people can and should interact are determined not through government regulation, but by the development of supportive code. Indeed, the original wiki platform did not feature such pages, and after substantial discussion and debate over Wikipedia's listserv, community member Clifford Adams customized the software to create these pages. (Lih, pp 65-66) One challenge for scholars interested in studying the web's impact on society is that new code is constantly being developed, and the seemingly impossible dilemmas of 2002 are rendered easily solvable by the new software architecture of 2009. Without discussion pages, Wikipedia would face steep challenges in supporting the NPOV norm. Rather than developing complex organizational bylaws and chains of command, Wikipedia and other online spaces incorporate new Code-based solutions that support community norms by making positive contributions easier and negative contributions harder.

The third attribute of Wikipedia's success is the core of initial editors – what I will refer to later in this paper as an actively engaged set of "lead adopters." (Von Hippel 2005) Wikipedia needed this initial group of committed, substantively knowledgeable, and technically skilled contributors because the value of the site is almost entirely derived from its network externalities. Consider the value of Wikipedia to the fifth contributor to visit the site compared to its value to the 5,000,000th contributor. Early on, the site is error-prone, full of topical holes, and of questionable quality. Later, it benefits from a phenomenon first described by internet ethnographer Eric Raymond when discussing the success of the open source software movement: "given enough eyeballs, all bugs are shallow." (Raymond, 2001)

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has a neutral point of view. (3) Wikipedia is free content. (4) Wikipedia has a code of conduct. (5) Wikipedia does not have firm rules.

[3] Excerpted from a December 5, 2005 interview with CNN. Quotation from Lin, pg 112.

Raymond had found that open source software is successful in direct proportion to the size of its community, because a software bug that seems tremendously difficult to one person is likely to be a simple fix for someone else. This network effects phenomenon has received various treatments among computer scientists, the best known being "Reed's Law," from David Reed, which suggests that the value of internet-mediated communities rises exponentially with the size of the network (because each additional member can engage in one-to-one or many-to-many communication, increasing the number of possible groups by one exponent). (Reed, 1999).

Jimmy Wales explains the success of Wikipedia in similar terms: "the technology required for Wikipedia is essentially rather simple. You need a database, you need a Web server, you need a Web browser, and you need the wiki editing concept. While the wiki concepts was invented in 1995 by Ward Cunningham, Wikipedia didn't start until 2001. So all of the technology, including the idea of a wiki, which is a web site that anyone can edit, has existed since 1995. …*The answer is, Wikipedia isn't a technological innovation at all; it's a social innovation*. What we figured out between 1995 and 2001 was not new technology. We had the Web already, but we discovered the basic idea of how to organize a community." (Lih, pg xvi emphasis added) This notion of Wikipedia as a community is of crucial importance for generating hypotheses about "open source politics" more generally. As the site has grown, it has added additional rules and it has empowered a layer of "superusers" with additional editing privileges as a reward for their positive contributions and as a means of engaging in distributed community management.

At base, what we find with Wikipedia is the same phenomenon Yochai Benkler describes in *The Wealth of Networks*. The lowered transaction costs of the internet enable elaborate structures of peer-production, often through armies of committed volunteers, that compete with and occasionally outperform firm-based production. This is not to say that hierarchically-managed firms will disappear in a sea of voluntarism – there are substantial limitations to "crowdsourcing" – but it is to say that the change in information regimes enables communities to engage in sophisticated mass collaboration, particularly in those areas of the web where large communities, effective norms, and supportive code have managed to congeal. Wikipedia has attracted such broad scholarly interest because it challenges not only the encyclopedia industry, but the foundational literature in political economy on the logic of the firm (Coase 1937, also Piore and Sabel, 1984).

Returning to the initial puzzle, none of these institutional structures necessarily explains why the public good known as Wikipedia avoids the pitfall of free ridership as laid out by Olson. One answer to that issue is to note that the great majority of Wikipedia visitors *do* in fact free ride. Wikipedia globally has about 75,000 "active" members. These are registered users who provide 5 or more edits to the site per month. About 10% of these are "very active" wikipedians, contributing 100 or more edits per month. Given the site's overwhelming popularity, with 8% of *all* Internet users visiting daily,[4] we can extrapolate that for every active content-producer, there are tends of thousands who free ride on the public good. Most users of Wikipedia do not take part in the editing or article-writing process, despite the

[4] http://alexa.com/data/details/traffic_details/wikipedia.org. This accords with the findings from the 2007 Pew survey, but tracks traffic on the global, rather than national, level.

tremendously low barriers to entry. So free ridership does indeed occur on Wikipedia, but it is not the problem that we would be led to expect. No one would likely say that the central issue for Wikipedia is that it is *under*provided.

Clay Shirky, Benkler, and Bimber, Flanagin, and Stohl all converge on a similar point: when the costs of participation in collective action approach zero, we face a condition of *abundance* rather than one of scarcity. People have limited time and limited money, but they have virtually unlimited opinions. What we see on Wikipedia is essentially a multifaceted version of what Olson termed a "privileged group."[5] When the good in question is not money or time, but rather specialized information, we find that there are plenty of people who are "wealthy" in some form or another. Put another way, most everyone has a hobby. Hobbyists have always happily incurred the "costs" of discussing their topic of interest, often in excruciating detail. When they do so on Wikipedia, they provide exactly as much of the public good (information about video games, the history of knitting, etc) as they themselves want, and this provides more than enough for inquiring minds.

This is not to say that mass collaboration, collective action, and the provision of online public goods is seamless and assured. Rather, it is to say that the shift from slower, costlier information regimes to an instantaneous, abundant online information regime creates a *different* dilemma for social engagement. Specifically, the geography-less, abundant online space creates tremendous challenges in *search*. How are we to identify good, verifiable information from bad? How are motivated partisans or hobbyists to find each other with no central square, and how are onlookers to take advantage of the fruits of these hobbyists' labor? Wikipedia critically benefits from the *network externalities* of all these hobbyist communities gathering in the same, identifiable location. If five sites all competed for the same niche of "online information hub," the sum of those parts would be far less than the whole found on Wikipedia. Indeed, initial developer Larry Sanger eventually left Wikipedia and started his own site, Citizendium.org, because he felt there should be a greater role for credentialed experts (Bruns 2008). In two and a half years, the site has built a small community of 800 contributors, authoring 10,700 articles in total and attracting a fraction of a percent of Wikipedia's audience.[6] For this reason, I depart from Lupia and Sin (2003) and Bimber, Flanagin and Stohl (2005). I would suggest that the critical challenge to online collective action is not public-private boundary-crossing or the declining value of selective incentives, but rather solving the search dilemma under conditions of abundance – a challenge which approximates a mass coordination game.

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[5] Olson suggests that two types of group will face minimal free rider problems. Small groups will be able to identify non-contributors, creating reputation pressures and incentives to recognizably participate (Chong, 1991, develops this case further with regards to social movements). Privileged groups feature a single wealthy participant who will provide as much of the public good as he or she likes regardless. If the wealthy patron has a strong enough taste for the good, all will be satisfied regardless of free riding.

[6] http://en.citizendium.org/wiki/CZ:About Also see http://alexa.com/siteinfo/wikipedia.org+citizendium.org

Hyperlinks, Hubs and Power Laws: Solving the Search Dilemma through Iteration

Before there was the World Wide Web, there was the hyperlink. Hyperlinks provide the networked structure of the internet, with clickable links embedded in text which direct a reader from one page of text to another. A solitary web page with no inbound or outbound hyperlinks lies, in a very real sense, at the periphery of the World Wide Web. Though such a page is accessible through direct input of its Uniform Resource Locator (URL: the text-based "address" appearing after http:// in the address line of a web page), one would be unlikely to stumble upon it through everyday surfing.

The hyperlink calls to attention two dimensions of the internet's novel search puzzle. First is the anti-geographic nature of the medium itself. Search in the offline world is aided by landscape-imposed scarcity. Towns and cities have physical centers and peripheries, and this translates directly into the price system of the real estate market. There is a cost imposed by being out-of-the-way, either for residencies (commute) or commercial zones (foot traffic and shopping districts). Thus restaurants tend to be grouped together, one can generally expect to find a pawn shop in close proximity to a race track, and proximity to desirable locations translates into higher rents. On the internet, by contrast, there is no physical landscape to traverse. As one example, consider the hundreds of millions of blogs have been created and then abandoned. This provides the slightest inconvenience for Google, the company upon whose server farms most of these sites are hosted, and whose search algorithm must handle them, but the realities of increasing bandwidth and transistor capacity relegates this to a minor nuisance at most. From the user's perspective, dead blogs and abandoned web pages do not litter any landscape, because the Web is composed of hyperlinks and we are never forced to traverse their pages in our daily online pursuits. An abandoned blog goes unhyperlinked, and thus floats to the periphery of web "space." The lack of geography on the web is a substantial component of the condition of information abundance found online. There is no such thing as "location, location, location."

The second dimension is the challenge for like-minded hobbyists of finding *each other*. Internet communication is instantaneous, but also asynchronous. One can post a message to a discussion board or send an e-mail alert and it will be immediately viewable, but as opposed to a phone or face-to-face conversation, replies do not necessarily come in real time. Lacking town centers, where are hobbyists, partisans, or other communities-of-interest to gather? With no town center, what good is a self-publishing soapbox, anyway? This is closely related with the problem of identifying verifiable information on the web. In essence, the internet lowers the communication costs for *all* types of publication and online group interaction. Scarcity provides some baseline assurance that a group or information source is reliable; the very act of publication or gathering indicates an ability to surpass some minimal cost threshold. Under the condition of abundance, how are we to tell reliable information from speculation? How are we to find other like-minded participants when there literally is no "there" there?

Hyperlinks provide the kernel of the solution, with Google's PageRank algorithm acting as pioneer. Prior to PageRank, internet search was tremendously problematic. The two standard solutions were to provide a top-down directory of all web pages or offer a search mechanism based on the appearance of keywords on a webpage. The problem with directories was twofold. First, the scale and rapid growth of the web meant that no directory could manage to be comprehensive. Second, directories are built around meta-level organizing assumptions about the categories a user will wish to search through. Thus AOL.com, for instance, could provide a list of topical headings such as "sports," "news," and "entertainment" and then further divide the categories into fine-grained subheadings. But a user interested in new banjo strings and information on an upcoming jamboree would have little idea where to begin. Keyword-based search could help with this, organizing results based on the combination of "banjo strings," and "jamboree," but separating new information from old becomes problematic, and such keyword searches are easily gamed. Google's ingenious solution was to include hyperlink data in the presentation of search results. Pages with numerous hyperlinks, particularly from other sites that are highly-linked, appear at the top of the results page. Thus google lets web users "vote with their feet," in a sense, indicating the quality of an information source based on the number of web users who have chosen to link to it. The simple inclusion of this network data in their search results is what led Google to rise from a tiny startup, three-person operation to the largest company in the online space. (Vise and Malseed 2005)

Physicist Albert Lazlo Barabasi offered an important early treatment of these link patterns on the web in a 1999 article in *Nature* Magazine. As he would later describe in his public-audience book, *Linked*, Barabasi was interested in the distribution of links among web pages. His early assumption had been that link distribution would approximate a normal curve, indicating that the web could be understood mathematically using the standard assumptions of random graph theory. Instead, Barabasi found that link patterns followed a heavily skewed distribution approximating a power law or Pareto distribution. Vilfredo Pareto initially observed these distributions in his study of wealth disparity in European societies, leading them to often be termed "rich get richer" or "80-20" distributions, since he found that 80% of a society's wealth was held by the top 20%, and that the greater the level of income, the more stark the disparity. Power laws are based on a decaying function in which the Nth-largest node is 1/Nth the size of the largest node. (Barabasi 2003) Clay Shirky and Matthew Hindman produced separate studies in 2003 demonstrating that the blogosphere in particular displays power law tendencies in its hyperlink distribution, leading to the emergence of an "A-list" or elite status among early political bloggers. Though there has been some debate as to whether these link patterns are a power law or some other heavily-skewed distribution (Drezner and Farrell 2008), what is of particular interest here is the *mechanism* that Barabasi tells us produces power law distributions.

Barabasi demonstrates in his article that power law distributions emerge in a network simulation when two simple conditions are present: (1) growth and (2) preferential attachment. Simply put, if a network is growing and new links between nodes are determined based upon the preferences of their observable neighbors, then a set of "hubs" will develop over time, as the link-rich are more likely to gain additional links, further increasing link disparity over time and, critically, developing a power law distribution. Growth plus preferential attachment leads to the emergence of power law hubs. This is crucial to the question before us in this chapter, because it serves as an iterated solution to the mass coordination problem we find online.

Let's say you are interested in discussing left-wing politics. Living in a conservative rural town, you would like to turn online in order to find other people with similar interests. Where do you go? Where are they? The previously-mentioned lack of geography provides a dilemma. You have no strong preference regarding the location of the conversation, and neither do the other members of your nascent community-of-interest. Your interest is in finding the same "place" online (and, later, in the place providing supportive environment for healthy, spam- and "troll-"free discussion and possibly tools for further collaboration). This is a classical example of a coordination game, in which actors have neutral preference rankings among options, but wish to arrive at the same solution as one another. In a single-iteration coordination game, this can be solved through sequential action: the first actor makes an arbitrary decision and all others follow suit. If actors move simultaneously, or without knowledge of each other's actions, the problem becomes far more challenging. But in an iterated coordination game, preferential attachment emerges as a viable and simple solution. In particular, a google search will reveal the most popular spaces where like-minded people are *already* meeting. Rather than selecting an online forum, blog, wiki, etc at random and hoping that a community-of-interest will show up, each additional latent community member can choose to rely on the actions of those who came before them.

Preferential attachment leads directly to the emergence of power-law hubs, and a general principle for web science practitioners: large hub spaces online are *different* than small spaces. The topology of the web, as it has grown over time, is ruled by power-law hubs such as eBay, Wikipedia, DailyKos, YouTube, MoveOn, and Facebook. Each of these "web 2.0" spaces offer value to their users in direct proportion to the network effects provided by large crowds of similar users. Online hub spaces move through identifiable phases of institutional development as they diffuse through the user population and face challenges related to scale and changing demographics and interests of different user classes.

The study of power law distributions in online politics is mostly attributable to Matthew Hindman's work, particularly his 2008 book, *The Myth of Digital Democracy*. Therein Hindman argues the emergence of power laws in online traffic creates a "Googlearchy," or google-imposed hierarchy, leading to heavy elite stratification and limiting the transformative potential of the medium. Working with traffic data supplied by *Hitwise*, Hindman argues that the barriers-to-entry online are not substantially lowered by the new media environment. Though the costs of self-publication have been dramatically reduced, those costs have been offset by the new costs of building a massive online audience. These power laws, to Hindman, are a problem; he argues that they represent the reemergence of elite politics that in turn limits the transformative potential of the online communication. While I do not dispute Hindman's empirics, the case of Wikipedia suggests that we should be circumspect about his interpretation. The Internet's power law topology means there can only be one hub site occupying Wikipedia's niche. But Wikipedia's users are not attempting to build Wikipedias of their very own. They are, instead, looking for a coordination point where they can access "the sum of all human knowledge." The path to power-law-hub status is a developmental process, and it yields a set of institutions that are substantially more open and participatory than those characterizing the previous information regime. The utility of power law hubs in solving the mass coordination problem has been largely ignored in the research literature thus far. By providing an iterated solution to the mass coordination problem present in the anti-geographic space found online, power law topology *facilitates* a revised logic of online collective action.

Institutional Development of Hub Communities: A Five-Stage Adopter Class Model

Wikipedia benefits from the power law topology of the Internet, developing a large community of participants, active and passive, and benefiting from the substantial network externalities that they provide. The rise from nascent startup to power law hub did not occur in a smooth progression, though. Wikipedia was able to succeed because its leadership skillfully and artfully moved it through a predictable series of development challenges that occurred as the community grew and changed. All such internet-mediated community spaces move through the same diffusion process as virtually any other new product or innovation: (1) beginning with a tiny group of lead adopters who co-create the good, (2) expanding to a larger early adopter class which is highly motivated but less technically skilled, (3) launching into the much larger early majority class, whose motivation and skill level is more varied and whose size pressures the system to adapt, (4) adopting protections against spammers and malicious attacks as the site attracts the late majority class and becomes recognized as "valuable online real estate," and (5) dealing with challenges to institutional power structures as growth slows at the laggard phase and questions regarding voice and equality rise to the fore. These stages are of particular interest because they accord both with Wikipedia's experience and with the longstanding literature on diffusion of innovations. (Rogers 2003) If Hindman and others are correct about the stability of power law hub sites online, then there can only be a small number of these online communities-of-interest, and their development pattern is itself an important topic for investigation.

A Brief Overview of the Diffusion Literature

The definitive text regarding diffusion research is *Diffusion of Innovations* by Everett Rogers. First published in 1962, the book is now in its fifth edition and has been cited over 19,000 times,[7] a testament to Rogers's longstanding impact on the field. Rogers notes that ideas, farm products, viruses, and a whole range of other innovations fit a standard "S-curve" as they diffuse through a community over time. Figure 1 offers a graphical representation of the S-curve, along with the five traditional adopter classes. Eric Von Hippel relabels the "innovators" as "lead adopters" in his book, *Democratizing Innovation*. He notes in that work that the first tiny group of adopters often help to co-create the good, repurposing it and providing feedback to the original firms or labs who are releasing the new product. This is particularly true in the computer industry, with beta-testers providing feedback to proprietary software companies and open-source programmers actively participating in the software development process. Following Von Hippel, I use the term "lead adopters" rather than

[7] Obtained through Google Scholar: http://scholar.google.com/scholar?hl=en&lr=&cites=7511022991152445218

"innovators" here (Von Hippel 2005). Note the relative size of the five adopter classes, with lead adopters being the smallest group, the early and late majorities making up the bulk of the population, and early adopters and laggards representing 13.5% and 16% of the population apiece respectively. This is based on an assumption that time-of-adoption follows a normal curve, with the early and late majorities covering one standard deviation from the mean, early adopters representing the second standard deviation to the left of the mean, lead adopters representing 2+ standard deviations to the left and laggards representing all adoptions occurring more than one standard deviation to the right. (Rogers, pg 281)

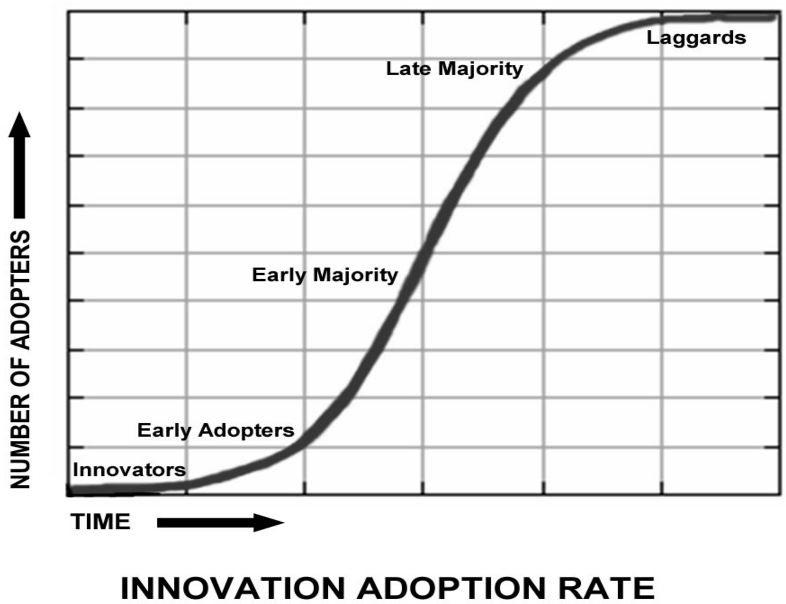

Figure 1: Standard Diffusion Curve[8]

One of the most important findings from the diffusion literature is that these adopter classes are demographically distinct from one another. Survey research has routinely found that younger, wealthier, better educated, and more "cosmopolitan" members of society have a stronger taste for innovation than their neighbors (Rogers, pps 272-282). Lead adopters and early adopters tend to have peer networks that span wide geographies, exposing them to new ideas and innovations long before their neighbors do. Thomas Valente further advances this notion of separate adopter classes in *Network Models of the Diffusion of Innovation*. Valente unites the longstanding diffusion research tradition with the emerging field of social network analysis, treating actors in a community as nodes in a network with varying adoption thresholds. He goes on to identify three critical mass points: one at the shift from early

[8] Image obtained through Google images: http://images.google.com/imgres?imgurl=http://www.cyfm.net/articles/images/S-CurveDetail.jpg&imgrefurl=http://www.cyfm.net/article.php%3Farticle%3DDont_Good_Ideas_Fly.html&h=900&w=900&sz=67&hl=en&start=4&sig2=aXHLBuRCvt8cFz6sdhO5Ag&tbnid=cAFVuhipoW-dfM:&tbnh=146&tbnw=146&ei=trjzR6K_FYyGeufesIgB&prev=/images%3Fq%3Ds-curve%2B%26hl%3Den%26lr%3D%26safe%3Doff%26sa%3DG

adopters to early majority, a second at the pivot point between early and late majority, and the third at the shift from late majority to laggards. (Valente 1995) This approach is particularly valuable because it suggests that not only are there differences between adopter classes, but there are also temporal differences between the various phases of adoption.

It is worth noting at this point a methodological difficulty in the diffusion and networks literatures. As Wasserman and Faust note in their text, *Social Network Analysis: Methods and Applications*, population definition is a crucial and troubling issue. (Wasserman and Faust 1994 pps 30-35) For early diffusion researchers studying farm implements, the population under study would be farmers in an identifiable community. For later research on drug development, the population would be medical doctors with a shared specialty and overlapping memberships in the American Medical Association. What is the population of potential Wikipedians, though? What about the population of potential Dean campaign participants, or Tea Party activists, or MoveOn members? Boundary definition can only be determined in retrospect for these groups, rendering social network analysis useful for theoretical exercises, but presenting steep data challenges for more quantitative work. For this reason, I use the diffusion and social networks literatures as a starting point for my descriptive model of institutional development in online communities-of-interest, but do not develop the model as a social network study per se. The data problems are, at this juncture, insurmountable.

Institutional Development Challenges Present at Each Adoption Stage

What should be clear from the diffusion of innovation literature is that the 5th Wikipedian is substantively *different* from the 5,000,000th Wikipedian. They have different backgrounds, different interests in the site, and different needs of the site architecture. The fifth Wikipedian is co-creating the online space. She is likely involved in writing software code or is particularly devoted to the creation of an open encyclopedia, an active participant in what Kelty refers to as the “recursive public” that participates in the production of Wikipedia. The five-millionth Wikipedian is visiting an established online space, looking up information of their own, and occassionally finding enough value in the space to add a few edits of his own. What’s more, these differences abstracted into a generalized pattern and applied to other online productive participatory communities. Effective launch of one of these communities, which I will hereafter term “network-enhanced goods” must move through five distinct phases: (1) initial launch, (2) reaching critical mass, (3) managing the influx of a mass public, (4) defending norms against newcomers, and (5) institutionalizing authority. I will discuss each stage in turn below:

Stage 1: Initial Launch

Recall again Jimmy Wales’s suggestion that the technology behind Wikipedia was both simple and available for years prior to the launch of the site. The success of Wikipedia was a story of community-building. If Wales and Sanger had announced Wikipedia with an aggressive television and newspaper advertising campaign, the site would have been an almost guaranteed failure. The mass audience would have visited an empty vessel populated by a few anonymous (and likely erroneous) entries, turned around, and never come back. But the initial Nupedia list gave them a small set of highly-motivated participants who could choose to contribute to the site because they individually found it a fascinating and worthwhile project. Their "adoption threshold" in the language of Valente, was tremendously low. The site also had the early blessing of Richard Stallman, founder of the Free Software Foundation and legend within the open source software community, and received an influx of tech-savvy participants through early discussion on the Slashdot.org discussion forum, described by Andrew Lih as "a salon for the technical elite and a grand senate of the computing community." (Lih, pg 67)

The attention of this lead adopter community is itself a scarce resource: they are, as a whole, well educated, urbane technology and academic professionals, with time for a few interesting side projects and a dense network of social ties. Benkler and Stephen Weber note that the personal incentive for these individuals lies in a combination of reputation-building incentives, socio-psychological incentives, and hedonic personal gratification at solving interesting puzzles (Benkler 2006. Weber 2004) Any online community-of-interest must attract a sizeable number of these lead-adopting co-creators, and that in turn means providing them with the freedom to make changes and provide input to the system. Internet communication may exist in an environment of information abundance, but the interest of these elites is a scarce and valuable resource, best attracted through technology conferences, highly-technical listserv discussion groups, and other traditional networking events that feature high barriers-to-entry. Though the identity of the lead-adopter community will vary from online community to online community (the lead adopters who populated the early political blogosphere were not the same people who populated early Wikipedia), they are invariably drawn from existing networks of influence – the underdefined "policy networks" discussed in the policy agendas literature, for instance (Kingdon 1984).

Stage 2: Reaching Critical Mass

"User-generated content," like "web 2.0," is an internet buzzword coming out of the marketing world that has taken on substantial meaning. Web 2.0 can be roughly defined as people finding each other online, whereas Web 1.0 consisted of people finding information online ("the information superhighway"). User-generated content refers to comments, information, conversation, or multimedia content that come not from top-down management, but from bottom-up, voluntary production. Several of the major online spaces (circa 2010) serve to aggregate and sort such content, including FaceBook (publicly articulated social network information), YouTube (video sharing), Flickr (photo sharing), the large community blogs, and of course Wikipedia. To the extent that internet mediated political associations rely on channeling the participation and interaction of their communities-of-interest, they likewise fit into this category. Critical mass refers to the point at which a site is receiving enough user-generated content that the network externalities produced exceed the interest threshold for the mass of less-motivated web surfers. Put another way, at some point Wikipedia has enough content to maintain the interest of people who do not self-identify as "techie" or "encyclopedia junkie." The addition of this larger swath of the public massively expands the community. As the nascent version of any of these sites expands into this early adopter phase, it must settle a series of technical and normative questions regarding how to handle growth and community contribution.

In Wikipedia's case, this included some complicated server load issues (Lih, pps 77-79) in 2004, as the number of total English-language articles surpassed 100,000 (about the size of the *Encylopedia Brittanica*) and increased traffic grew to the point where the site would often crash. The involvement of technical elites was critical to solving these problems, and all growing online communities must either attract the sustained interest of the open source community or maintain a large budget for proprietary software solutions to this aspect of scaling. Lih records that, in the same time period, "because the community was growing so quickly, the process of forming consensus by email did not scale." (Lih, pg 95) The consensus and co-creation practices that were necessary to attract and keep the lead adopter community had to be modified in order to allow for the early adopters, who by and large displayed a keen interest in the system, but were less technically experienced and lacked deep existing network ties with one another. Wikipedia responded by creating a distributed moderation system of superuser "administrators," moving mailing list-based discussion to a separate section of the wiki dubbed the "village pump." As Wikipedia attracted enough user-generated content to become self-sustaining, then, the system had to adopt new Code-based solutions to the surge of traffic.

Stage 3: Managing the Influx of a Mass Public

As the site reaches Valente's first critical mass point (Valente 1995), it must deal both with a tremendous surge in traffic/participation and also adapt to a mass public that does not share the particular interests of the lead and early adopters. While lead adopters are contacted through existing social/professional network ties, and early adopters are contacted through niche media outlets (coverage in *Wired* magazine being particular coveted by many social media ventures at this stage), the shift to early majority is often accompanied by coverage in traditional media venues. Wikipedia had attracted a few brief mentions in the mainstream media during its first few years, but its breakthrough moment occurred during a well-publicized controversy in December, 2005. John Seigenthaler, former editor of *The Tennessean* newspaper, noticed some incorrect and libelous information posted in his Wikipedia entry. Seigenthaler contacted the editors, who immediately changed it and apologized, but Seigenthaler went on to write a scathing Op-Ed for *USA Today* on Wikipedia's unreliability regardless. The Op-Ed produced ripple effects, with other television and newspaper outlets writing stories about the story. (Seelye, 2005) For millions of Americans, this coverage was their first introduction to the site's existence, and the negative news served as free site publicity that significantly increased traffic and content-creation.

In the history of Wikipedia, this is referred to as "the Seigenthaler effect." Figure 2 demonstrates the growth in Wikipedia page views pre- and post-Seigenthaler Op-ed. The upward trend in views continued unabated, as Wikipedia grew to its present-day status as the 6^{th} most-visited website in the world. This sustained growth would not be possible prior to the normative and technical problem-solving occurring in stage 2 – the site would lack a vibrant community and also lack the capacity to deal with the sudden influx of users. As-is, the arrival of the early majority signaled a change in the character of the site, as the culture of "ignore any rules that get in the way" had to stand up to the rush of onlookers less sure of their co-creating skills and more interested in a simple set of guidelines for what can and cannot be done. It is generally during this third stage that many of the lead adopters, faced with changing community norms and an increasingly noisy environment, depart for some new project or create their own sublist, complaining about how the community has been degraded by the onrushing newcomers (Shirky 2008).

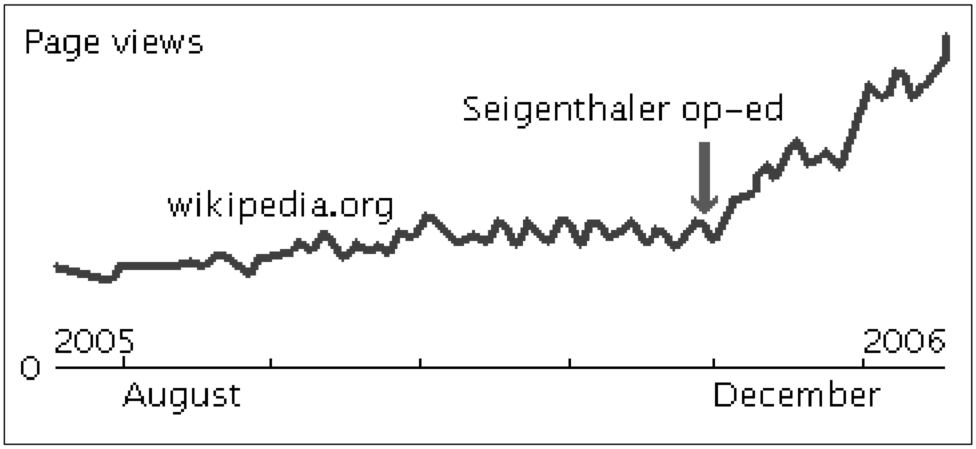

Figure 2: Growth of Wikipedia Page views pre- and post-Seigenthaler Op-Ed[9]

Stage 4: Defending Norms Against Newcomers

As the online community passes Valente's second inflection point, growth is at its highest rate and the network externalities have rendered the space a clear power law hub. At this point, the site becomes known as "valuable online real estate." A new wave of challenges comes with such a distinction, as malicious users attempt to subvert the network for their own gain. Wikipedia has remained surprisingly robust against these challenges – a credit both to the technical solutions it has created and the participatory community it has enabled. But two examples of this challenge demonstrate the general point. On July 31st, 2006, political humorist Stephen Colbert featured Wikipedia in a segment of his television show, *The Colbert Report*. Describing Wikipedia as a space where, "any user can change any entry, and if enough users agree with them, it becomes true," Colbert told his viewers to go onto Wikipedia and edit the article on elephants to say: "Elephant population in Africa has tripled over the past six months." The flood of user-edits forced site administrators to temporarily lock the page. In a less congenial spirit, companies and political aides have gotten into the habit of anonymously grooming their entries. Zittrain elaborates the tension admirably: "If the Wikipedia entry on Wal-Mart is one of the first hits in a search for the store, it will be important to Wal-Mart to make sure the entry is fair – or even more than fair…" (Zittrain, pg

[9] Data compiled for "History of Wikipedia" by user "TakuyaMurata." Image available at http://en.wikipedia.org/wiki/History_of_Wikipedia under Creative Commons license.

139) Likewise, August 2006 saw the launch of MyWikiBiz, a company aimed at creating and editing Wikipedia entries on a for-fee basis. Jimmy Wales responded by blocking the company's user account and banning their I.P. address, and this led to a lengthy community discussion about how to deal with such new ventures. (Zittrain, pg 140)

The "valuable real estate" issue has important implications for the growth of online communities in areas that have *already* been identified as valuable. When the *L.A. Times* attempted to embrace the wiki editing concept through the launch of "wikitorials," the site was almost immediately overrun by porn advertisements and was quickly shut down. Clay Shirky writes, "in the absence of a functioning community, a wiki will suffer from the Tragedy of the Commons, as the Wikitorial did, as individuals use it as an attention-getting platform, and there is no community to defend it." (Shirky, pg 137) Karpf (2009b) identifies a similar trend impeding nascent conservative online political communities in their efforts to build parallel infrastructure to the progressive "netroots."

Stage 5: Institutionalizing Authority

Throughout the first four growth phases, we see a continuous fraying of the principles of openness and co-creation that mark the earliest stages of a participatory community. As sites enter the laggard phase (which I will again note, can only be methodologically defined with rigor retrospectively), the slowdown in site growth raises inevitable questions of power and authority among the now-stabilizing community. Within Wikipedia, one such controversy occurred when longtime site administrator "Essjay" was revealed to have falsified his credentials. Although Wikipedia is open to editing from anyone, Essjay had claimed on his personal page that he held various graduate degrees and a professorship in Theology. He had made reference to this educational background when arguing on various "talk" pages over the years. In 2007, after Jimmy Wales contacted him about joining a for-profit venture, it turned out that Essjay was a 24-year-old editor with no graduate degrees. This led to a long community discussion regarding the validity of his edits, the issues of identity-management in the online space, and the proper role of expertise in Wikipedia. (see Zittrain pg 141, Lih pps 194-200 for further discussion)

As growth slows in this final phase, when most potential community members have joined the site and the remainder of the online population is mostly non-adopters with a few laggard adopters still present, the disparity between hubs and niches comes into stark contrast. While the periods of rapid growth provide a sense that the entire world is changing, the final phase raises questions about who controls the fruits of all this volunteer labor. These changes have been somewhat muted in Wikipedia because the site is a nonprofit, nonpolitical venture. But in other communities-of-interest, particularly ones where a company or political leadership is seen to profit from the voluntary output, the challenges to institutionalized authority can be particularly problematic. The differences of scale that have developed become differences-in-kind, with Larry Sanger's attempt to start his own equivalent to Wikipedia, Citizendium.org, being an instructive case. As internet publisher Tim O'Reilly has put it, "If there weren't a network effect driving Wikipedia, [Google's] Knol and Citizendium would be succeeding."[10] The powerful network effects that define these online spaces also prevent alternative ventures from successfully growing to scale. If you don't like Wikipedia, DailyKos, or Facebook, you are free to start your own, but that in itself is problematic.

If the power law topography creates these differences-in-scale among the sites that allow for novel solutions to the collective action problem, then we must wonder about the conditions under which a power law hub can fall or be replaced. The next section will discuss how each of the five institutional development stages listed above produces a challenge which can lead to the failure or replacement of a network-enhanced good, leading to a set of hypotheses about the parameters within which potential network-enhanced goods can be developed.

Stumbling Along the Path to Power Law Hub-Status

Phase 1

The first challenge for potential hub spaces lies in attracting a devoted set of lead adopters. This problem can come in at least two forms, depending on the availability of a pre-existing power law hub. In the case of Wikipedia, for instance, the first wave of adopters came from the Nupedia list and from the Slashdot community. The Slashdotters were particularly attracted to Wikipedia because of its novelty. Likewise, the Howard Dean campaign featured the support of dozens of leaders in the field of social technology who were attracted by the new opportunity to apply the principles of open source to a political campaign and see what happened. Attempts at replicating these successes must find some other reason why technological or topical elite networks would choose to engage in peer production through that particular venue.

This point seems lost upon the hundreds of organizations and companies who have decided to enter the "web 2.0" age by launching their own social networking sites, for instance. A useful indicator is the existence of a McDonald's social networking site. Millions of Americans eat at McDonald's, but how many of them wish to self-identify as members of the "McDonald's community?" Pushed forward by a consulting industry that has found lucrative contracts in supporting the growth of social media, the very real public goods produced by online communities-of-interest can be easily obscured if we look at the social media industry as a whole. Without a colonizing set of devoted, skilled volunteer participants, the best technology in the world will fail to deliver the valuable network externalities that make these spaces worth regularly visiting. In a similar vein, Karpf argues in a forthcoming JITP article, "Macaca Moments Revisited" that the primary impact of new media on politics is only identifiable through the study of large-scale communities-of-interest, rather than the isolated study of specific new media tools such as YouTube (Karpf 2010b). The impact of the internet on political associations and politics in general comes not through lowered communication costs alone, but through the communities-of-interest that these lowered costs enable. The first step in building such a community lies in attracting a set of active co-creators, and these co-

[10] See http://radar.oreilly.com/2008/10/network-effects-in-data.html

creators are themselves a scarce commodity. This leads to the first testable hypothesis, which could also be termed the "Field of Dreams Fallacy:"

> H1: Successful Web 2.0 institutions must rely upon the early participation of an active set of lead adopters, often to be found through existing networks and channels.

If H1 is correct, then it follows that optimism about "open source politics" must be tempered by a recognition of existing power relationships. It simply is not the case that "if you build it, they will come." Rather, existing networks of elite actors must be courted and brought aboard. Whether these are members of the "Technorati" or other social, political, or media elites, they represent a preexisting set of "haves" whose participation is a necessary condition for the success of even such open, egalitarian architectures as the one found on Wikipedia.

Phase 2

The move from lead adopters to the larger set of early adopters has a different bundle of challenges. Lead adopters are a valuable commodity, but they also have many interests that are distinctly different from the rest of the population. Reaching critical mass requires that a site not only solve a series of technical and normative challenges; it also requires the new community to exist in an area which is attractive to a substantial issue public. Shirky writes about a variant on this hurdle in his 1999 essay, "The Interest Horizons and the Limits of Software Love." Responding to Eric Raymond's then-recent summary of open source, that "every good work of software starts by scratching a developer's personal itch… given enough eyeballs, all bugs are shallow" Shirky notes, "What if you have a problem that *doesn't* scratch some core developers personal itch?" (Shirky 1999) Within the restricted universe of software development projects, some ideas will be more exciting and motivating than others. The least exciting ideas may still have a commercially-viable market, but they are unlikely to attract a large enough community of motivated developers to be appropriate for commons-based peer production.

This critique holds for the formation of online communities-of-interest as well – not surprising, given that Wikipedia and other such communities took inspiration from the open source software movement. The lowered transaction costs of the internet help to reveal the full demand curve for public participation, but part of what that means is that topics or areas that simply aren't particularly attractive or interesting to any existent or nascent issue public will fail to reach critical mass. The first generation of social scientists to study the internet were optimistic that, thanks to the falling costs of online engagement, we would see the rise of mass deliberative spaces, "online public squares" and other venues for enhanced democratic participation. Many such sites have been launched with enthusiasm, only to fail to reach critical mass. There are several potential explanations for such failure, but one of them is that public interest in lengthy deliberative processes simply isn't as high as social scientists would ideally like. (see Schudson, 1999 for a similar historical discussion) One limit of peer production which will hamper communities-of-interest is the inability to attract a large enough community to pass the critical mass point where the user-generated content itself gives people a reason to regularly return to the online space. This leads to a second hypothesis, termed the “interest horizons” thesis:

> H2: Transition from an active lead adopter community to broader participation is limited by existing preference schedules. Where there is little mass interest in a topic area, commons-based peer production will remain inferior to other methods.

If H2 is correct, then this suggests much about the practical limitations on open source politics. The Obama campaign, for instance, featured many “open source”-type activities. Will the relative successes of a site like My.BarackObama.com be replicable for a local county council candidate in 2010, however? H2 would suggest not, for the simple reason that presidential campaigns attract much greater public attention than local races. Presidential campaigns – Obama’s in particular – are much higher on the *demand curve* of the American public than any other electoral campaigns, and thus there are “open source” activities that can only be successfully applied in such settings.

Phase 3

Often launched by some event that exposes the hub space to the population through the mass media, the third phase is where substantial scaling and network effects begin to take hold. An important related challenge at this juncture is the availability of a distributed reputation system capable of managing this scaling process. As discussed by Benkler (2006), Bruns (2008), Resnick (2006), Karpf (2010a), and others, online reputation systems are a necessary component of all hub spaces within the power law topography of the internet.

A “benevolent dictator” such as Jimmy Wales can play a guiding role in the first two phases of growth, but in phase three, communities of interest quickly learn that “Jimmy doesn’t scale.” (Lih, pg 179) Slashdot’s “mojo” system and eBay’s “feedback forum” are the two best-known examples, but Google’s PageRank algorithm has similar functions, drawing upon a large set of distributed reputation assessments, then applying some form of algorithm that rewards good content or contributions while sanctioning bad content or contributions. Yochai Benkler notes in *The Wealth of Networks* that an effective reputation system is a necessary condition of large-scale peer production. He goes on to suggest that the components of peer-produced systems can be broken down into smaller components (“Modularity”) and that these components themselves can then be reduced to tasks that require little time and effort (“Granularity”). (Benkler, pg 100) Benkler illustrates these points by drawing upon the set of existing online reputation systems, but in so doing he overlooks an important caveat: some types of mass collaboration are much more easily reduced to small actions taken in front of a computer monitor than others.

This represents a substantial limitation to the internet’s impact on political associations. Wikipedia, DailyKos, MoveOn, and other large-scale communities-of-interest are capable of overwhelming growth with low overhead costs because they are asking their community to engage in distributed tasks that can occur effectively in front of a computer screen. One challenge that internet-mediated political advocacy groups like MoveOn and Democracy for America have faced when they attempt to use “online tools for offline action” is that the slight increase in transaction costs – asking people to rate meetings after they return home to them, for instance – is accompanied by a steep drop-off in participation.

Karpf (2010a) argues that these limits are changing thanks to the diffusion of the mobile web (internet-through-iPhone), but it is still to early in the diffusion process tell whether that hypothesis will be supported by the data. For our purposes here, it bears noting that the impact of the internet on offline collaborations is slim when compared with its impact on online collaboration. Potential power law hubs can only radically scale up if they adopt a system to manage the influx of participation. Such systems of reputation and recommendation are not equally applicable to all forms of collaboration and engagement, and where they cannot yet be built, commons-based peer production will fail to displace traditional modes of association and production.

> H3: Commons-based peer production will be limited to those tasks or activities that can be reduced to suitable levels of modularity and granularity. Many complex tasks will remain outside of these boundaries.
>
> H4: The spread of the "Mobile Web" should relax many of these limitations by enabling new advances in the field of online reputation systems.

Phase 4

By the fourth phase, a site has managed to attract mass attention and benefits from substantial network effects. What is to stop it from continuing in this regard? The brief history of social network sites (SNS) offers a useful illustration. Friendster.com was the first SNS to pass critical mass and attract large-scale participation. Danah boyd chronicles the demise of Friendster, eclipsed by Myspace.com because MySpace offered a more permissive culture, inviting bands to start their own pages and letting users create fake profiles for schools, organizations, and celebrities. Friendster had a network externality-advantage, because more people were initially on its site, but low online transaction costs meant that people could add a MySpace account in minutes, and with greater freedom on MySpace, they eventually switched en masse. Boyd attributes the replacement of Friendster by MySpace as an indicator of "internet culture." (boyd 2006; boyd and Ellison 2007)

MySpace indeed gained millions more users than Friendster, as SNS's gained further penetration among the public at large. Matthew Hindman notes that, prior to June 2007, MySpace was stably among the top five web sites in the United States. In his research into the stability of power laws on the web, he notes that MySpace precipitously dropped that June because the site "became uncool."[11] In the months leading up to that decline, MySpace had become barraged by spam solicitations, as pornography marketers took note of its status as "valuable online real estate" and began creating fake accounts. Viruses also became a problem around this time. Critically, Facebook.com replaced MySpace at this time, and it

[11] Research presentation at the Oxford Internet Institute, March 2009. Available online at www.oii.ox.ac.uk

remains the SNS power law hub today. Facebook included more limiting user registration permissions, and only allowed members of an individual's school-based or geographic network to view their profile. Perhaps more importantly, in May 2007, Facebook unveiled a new feature: its open application programming interface (API). The open API allowed outside developers to write new programs, including games and information-sharing tools. Facebook replaced MySpace as power law hub not because of culture, but because the open API gave users something new to do. Failure to respond to the pressures of being "valuable online real estate" rendered MySpace vulnerable, and when Facebook gave users new engagement opportunities, MySpace was left as a virtual ghost town, with over a hundred million registered users, most of whom were suddenly spending the bulk of their time on another site.[12] (see Boyd 2009 for a more detailed argument regarding the socioeconomic effects of this "Myspace flight.")

The lesson we should draw from the history of social network sites is that, although power law hubs benefit from substantial network effects that render substantial stability in the short run, viewed over a long time horizon the hubs seem more fragile. The internet is a fast-changing environment, and lead adopter communities tend to desert an online space once it gets too noisy and crowded, moving on to experiment with the next wave of innovations. Just as Compuserv, AOL, and Geocities were once defining features of online "geography," only to be relegated a few years later to the dustbin of history, the changing nature of the internet creates room for a host of "disruptive innovations" (see Karpf 2009 for further discussion) that can lead to the displacement of existing hub communities. This leads to H5, or the "disruption thesis."

> H5: The displacement of an existing power law hub by a new entrant will be facilitated by the development of new capacities, in accordance with Christensen's work on disruptive innovations.
>
> H6: Viewed as a time series, individual topic areas online will demonstrate "punctuated equilibrium" characteristics, with long periods of stability, followed by a power law hub being replaced by a new upstart.

H5 suggests that, as the internet continues to evolve as a medium, power laws may turn out to be less stable than they at first appear. New startups invest in capacities of the web at time T that were not present at time T-1, and in the lowered transaction cost digital environment, this can lead to the replacement of one hub with another. The requirements of the mass coordination dilemma require that the environment will continue to only have one central hub per area, but those hubs can be replaced in a predictable manner. Likewise, H6 posits that the apparent stability found in the online landscape may bear a strong resemblance to the stability found in the policy subsystems literature (Baumgartner and Jones 1993). At a single point in time, policy subsystems appear stable and unchanging. Viewed over a 30 year timeframe, they instead reveal short periods of disruption, followed by the establishment of a new systemic hierarchy.

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[12] This last point presents a host of measurement issues for social scientists interested in the internet. User accounts, once created, are rarely destroyed. Competition between social networks, community blogs, or internet-mediated political associations must be measured in activity, rather than list size. Unfortunately, activity measures are almost universally proprietary data, when they are available at all.

Phase 5

The governance challenges presented in the fifth and final stage are difficult to describe in great detail, particularly because of the data limitations present when applying social network analysis to online communities-of-interest. I cannot say with certain whether Wikipedia or more political hub spaces have actually entered the laggard phase of adoption, because we do not know at present what percentage of the online population is "non-adopters" rather than laggard adopters. What should be clear, however, is that the slowdown of site growth creates pressures regarding who controls the fruits of the community's labor. As one participant in the participatory ratings site Yelp.com explained regarding her superuser "elite" status," "It makes you feel special for about two weeks. Then you either realize you're working for someone else without getting paid, you totally lose interest, or you get really into it." (Zittrain pg 146)

Sites that fail to effectively manage these governance challenges are at serious risk of "code forking," the term Stephen Weber uses to describe subsets of the open source software community who break off from a large project to start their own similar endeavor. (Weber 2004) Code forking is not inherently a negative attribute – for certain types of community, particularly ones whose collaboration is not particularly granular or modular, there exists a "crowding threshold" above which additional members detract from the community (see Ciffollili 2003 for a related discussion of Club Goods theory). Too much code forking can reduce the network externalities produced by the community, and if one of these forked communities successfully passes the critical mass point in phase 2, then it begins to present a viable alternative to community members who become disaffected over the governance controversies. Likewise, the community must deal with these governance challenges while also embracing new Code-based innovations, otherwise it runs the risk of being displaced by a new entrant that suddenly offers community members an augmented set of opportunities.

> H7: Once the phases of rapid growth have concluded, communities associated with "open source politics" will engage in a series of "code forks" in reaction to intra-network disputes and clearer recognition of the demand curves of the associated issue public.

If H7 is correct, it provides a counterpoint of sorts to Hindman's suggestion that power law hubs reduce the democratizing effects of the internet to "mythological" status. For while there can be only one central information hub, audience-share is not the only goal of online citizens. If networked publics are able to successfully code fork, and in so doing enable a greater number of small- or medium-sized groups to efficaciously engage in collective action, then the limitations of power law topology prove a good deal less limiting.

Conclusion

The central purpose of this paper has been to derive a set of hypotheses about the heretofore underdefined field of "open source politics" from the heavily-researched commons-based peer production success represented by Wikipedia.org. In the process of developing these hypotheses, the paper has articulated several core concepts about internet-mediated communication, and also offered a look at how the standard diffusion-of-innovations process influences the institutional development of online communities.

A key component of the argument lies in the reinterpretation of what power laws in online traffic actually represent. Whereas previous scholars have taken the existence of power laws to indicate a stark limitation on the democratizing impact of the medium, this paper argues that "power law topology" is of critical importance in solving the collective action problem under conditions of abundance. Whereas traditional research on collective action and public goods problems has focused on the free rider problem, it is self-evident that Wikipedia has no *problem* with free ridership per se. Rather, the problem with online communities of this type lies in coordinating activity in an anti-geographic landscape. Preferential attachment serves as a solution to that challenge, and when combined with the growth inherent in a diffusion process, preferential attachment produces power law distributions. Power laws then serve to solve the anti-geographic challenge presented by the internet's abundance.

The paper concludes with a series of hypotheses specifically because it is my belief that the field of "open source politics" is still in its formative stages. Open source software and other commons-based peer production activities can be of great utility in developing this field, but only through a process of actively theorizing what elements of those fields should realistically be expected to translate over to the political realm. The hypotheses in this paper are meant as a challenge of sorts, both to their author and to the research community as a whole. Web research faces the challenge and the opportunity of having massive amounts of data, much of it noisy. In the aftermath of the Obama electoral victory, there is no doubt that "open source politics" will gain currency among the salesmen and hucksters of political campaign panaceas. If these hypotheses are right, where should we predict the next wave of successes to emerge? If they are wrong, how can they best be improved? In such a fast-changing landscape, clear articulation of hypotheses is itself a substantial undertaking.

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Open Source as Practice and Ideology: The 2003-2004 Howard Dean Campaign's Organizational and Cultural Innovations in Electoral Politics

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Abstract

This paper analyzes how 'open source' works at the level of both practice and ideology through detailed analysis of Howard Dean's 2003-2004 campaign for the Democratic presidential nomination. Extending an emerging body of work that documents the migration of open source practices into domains outside of technical production, through interviews with key staffers and analysis of public documents this paper shows how many of Dean's technology-proficient staffers used collaborative, open source production as a model for their campaign practice. In the process, they helped create a series of technical and organizational innovations in online fundraising and electioneering. At the same time, staffers strategically and publicly deployed the frame of the 'open source campaign' as a cultural resource. Situated within narratives of the new economy and participatory democracy, staffers' framing of the campaign as a radical techno-democratic effort provided journalists with an interpretive framework for understanding Dean's run and helped mobilize and motivate specialized volunteer constituencies. Given that the campaign was not as participatory in substantive domains as the open source frame suggests, this paper also reveals how actors can use the label of open source to elide dynamics of power and interest.

Keywords: Open source politics, electoral politics, framing, Howard Dean, Internet, democracy

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During the spring of 2003 a startling new phrase appeared in conjunction with a political campaign. Joe Trippi, the kinetic campaign manager for Howard Dean's presidential primary run, told every journalist who would listen – and there were very many – that the campaign was a revolutionary new "open source" effort. A couple of months later, in the thick of the primary battle, a journalist from Slate noted that: "the metaphor of choice for Howard Dean's Internet-fueled campaign is 'open-source politics': a two-way campaign in which the supporters openly collaborate with the campaign to improve it, and in which the contributions of the 'group mind' prove smarter than that of any lone individual (Suellentrop, 2003)." Just as Linux involved thousands of individuals across the globe working together to develop an operating system, Trippi and other Dean staffers and advisors argued that supporters independently collaborating powered the campaign. This new spirit of technologically-enabled campaigning seemingly promised nothing less than a revolution in political life. As Dean advisor and Internet scholar David Weinberger put it: "the campaign is willing to be truly democratic in a way that is really different (Tischler, 2003)."

By the fall even many hardened political journalists breathlessly referred to the campaign as a novel, open source effort that was upendeding traditional campaign methods and overthrowing party elites. What else could explain how Dean had raised three times more money than his nearest rival John Kerry over the summer, despite a lack of elite support and name recognition? How were journalists accustomed to big money donations and party insiders to explain the fact that 150,000 people either donated to or supported the campaign online (Fineman, 2003)? Or the fact that 33,000 individuals across the country came out on a Dean "Meetup Day," facilitated by the commercial Website Meetup.com, one Wednesday night in August? There was such little precedent for this shocking demonstration of electoral support so early in the campaign cycle that many journalists took Steve McMahon, Trippi's business partner and senior strategist for the campaign, at his word when he declared: "We have tapped into a force no one can fully control. I hope you guys remember that when something goes wrong (Fineman, 2003)."

Scholars such as anthropologist Chris Kelty (2008) have powerfully documented "modulations" of the open source/free software movement in domains far afield from technical production, from the collaborative online encyclopedia Wikipedia to the flowering of social expression secured by Creative Commons. Beyond any single project, however, practices of openness and collaboration appear to many to be a highly compelling and meaningful new model for organizing technical, economic, and cultural production. As Kelty reveals, open source is best conceptualized as a movement that has far reaching implications for much of political and social life, in both its very form as a set of value-laden practices and the products that result from such large-scale, decentralized, and public collaboration.

This paper shows how many of Dean's staffers working with the Internet and volunteers on technical projects were inspired by the ideals and practices of the open source movement and sought to apply them to the domain of electoral politics. The chief architect of the campaign was Trippi, a veteran of both political campaigning and the dot.com economy, who described his founding vision as wanting "to use the collaborative nature of open source, where more people filling holes makes it more stable and effective (Cone, 2003)." Many staffers echoed Trippi in citing how open source guided their own work, especially those within the campaign's Internet Division, the central site for technical experimentation.[1] These staffers often conceptualized their roles as simply supporting a vast, distributed volunteer community engaged in such activities as developing campaign tools, responding to attacks on the candidate on blogs, writing letters to voters in early primary states, and raising money for Dean's run. This seemed the very definition of open source. Indeed, Dean's staffers and volunteers even used and developed open source technologies in their work because they would "jibe with the movement part of the campaign" (Jerome Armstrong, personal communication, November 21, 2008), despite the fact that other campaigns could potentially use them.

As these staffers adopted the ethos and practices of open source technical development for their work, the campaign became a site of significant technical and organizational innovation in fundraising and electioneering. Online campaigning in previous election cycles was generally limited to "brochureware," static versions of campaign literature designed to sway undecided voters (Foot and Schneider, 2006). Yet, this was an ineffective tactic given that most visitors to campaign Websites were already sympathetic to, if not supporting, the candidate. Given this phenomenon, scholars such as Bimber and Davis (2003) presciently suggested that campaigns would increasingly use the Internet as a tool for mobilization. It was the Dean campaign that effectively realized this potential. As a number of scholars note (Chadwick, 2007; Jett & Välikangas, 2004; Stromer-Galley & Baker, 2006; Wiese & Gronbeck, 2005), Dean's staffers created a campaign blog, the first in presidential politics, developed an early social networking platform and personalized fundraising tools, and welcomed supporter involvement in many finance and field efforts. For example, the campaign provided citizens with digital tools that enabled them to host events, build their own Websites, and set fundraising goals and reach out to their friends and family for contributions. These innovations, in turn, spread across Democratic electoral politics. Many technical staffers founded consulting firms shortly after the primaries, carrying Dean's tools and organizational practices with them to other sites, culminating in Barack Obama's historic bid for the presidency (Kreiss, 2009b). After Dean's run, Democratic campaigns used the Internet as an organizational tool much more fully integrated into campaign operations, decentralizing fundraising, voter identification, and turnout.

At the same time, this paper reveals that open source served as a "cultural resource" (Snow and Benford, 2005) for the campaign. Trippi and other Dean staffers and advisors framed the campaign's uptake of the Internet in ways that connected to narratives of the new economy and participatory democracy. As they did so, they legitimated the electoral effort for journalists and attracted and motivated the labor of Dean's supporters. Notions of the open source campaign, coupled with performances of online politics such as fundraising events, served as compelling news hooks that attracted press attention and provided an interpretative

[1] The formal Internet Division consisted of approximately twelve staffers within the larger campaign organization. There were also a number of staffers' whose work revolved around the Internet and the campaign's technical systems in other divisions such as Field, Communications, and Finance. These individuals often worked closely with the Internet Division, so much so that divisional affiliations and reporting were not always clear. When I reference the 'Internet Division' in this paper I am referring to this larger group of staffers whose job responsibilities primarily entailed working online with supporters or developing the campaign's technical infrastructure. For a fuller discussion of the campaign organization, including an organizational chart, see Kreiss (2009a).

framework for journalists writing about the campaign. Meanwhile, the symbolic work of Dean's staffers helped the campaign recruit highly-skilled, technical volunteers and mobilized supporters. This framing also allowed supporters and staffers to imagine their work in ways that elided power dynamics on the campaign. A campaign hierarchy limited the Internet Division's work and much supporter participation to "backend" fundraising and voter outreach (Hindman, 2007). This formal organization held centralized control over the more substantive aspects of the campaign, ranging from the policy platform of the candidate to electoral strategy -- a fact that became painfully clear to supporters after the candidate's disastrous third place finish in the Iowa caucuses (Kreiss, 2009a). In this sense, open source served the ideological function of allowing many of Dean's staffers and foot soldiers to imagine themselves as part of a broader movement engaged in a project of techno-democratic reform, even as their participation was limited to tasks long institutionalized in electoral politics.

This paper adds to the broader literature on open source as a set of ideals, practices, and processes in looking to the ways individuals can strategically claim to represent the movement. Scholars such as Kelty and Gabriella Coleman (2009) have revealed the political sensibilities that underlie much of the open source movement. Work by scholars such as Yochai Benkler (2002, 2006) points to the economic and cultural impact of distributed, voluntaristic collaboration, while Stephen Weber (2004), Paul Duguid (2006), Eric Raymond (1998a, 1998b), and Clay Shirky (2008) have analyzed the social processes that underlie this new form of production. Along with extending this work in revealing how the Dean campaign became a site of electoral innovation, this paper draws from a body of movement theory to show how social actors utilize frames and technologies as cultural resources. In this sense, this paper shows how open source is not the exclusive purview of activists seeking to bring about changes in organizational life or intellectual property, but a cultural resource that can be appropriated by strategic individuals and enrolled into a number of projects.

As such, this paper suggests the complexity of "modulations" of the core components of open source (Kelty, 2008). The Dean campaign was an entity with competing "institutional logics," or the "belief systems and associated practices" (Scott et al., 2000) of a field. Many of Dean's Internet Division and other technical staffers did indeed see the campaign in terms of the open source movement, experimenting with practices of openness, sharing, and collaboration in their work. Yet, the Internet Division was embedded within and accountable to a formal organization staffed by political professionals with very different understandings of how political campaigns should be run and accountable to a different set of external actors such as elected officials, party leaders, the press, and governmental agencies. Dean's campaign then reveals how modulations of open source practices can take root in a local context, yet still be subject to larger governance structures. Given this, the question of whether Dean ran an "open source campaign," which Hindman (2007) so effectively took up, can obscure important nuances in modulations of open source. The more open and dynamic aspects of the Internet Division existed inside a hierarchical campaign structure that limited these staffers' work to domains such as fundraising, technical development, and volunteer operations.

I draw my evidence for this paper from open-ended interviews conducted over the last two years with twenty-one alumni of the Howard Dean campaign, including staffers of the formal organization, advisors to the candidate and campaign manager, and project-based consultants. I also used databases such as Lexis/Nexis and the Internet Archive to gather and analyze over 500 documents relating to the 2003-2004 election cycle. These include, but are not limited to, professional press articles, blog posts, campaign Websites, and e-mail campaign communications. I also utilized the work of a surprising number of bloggers, campaign staff, and volunteers that reflected on the campaign in blog posts, articles, and books such as Trippi's auto-biographical The Revolution Will Not be Televised and Teachout and Streeter's edited collection of first-hand accounts of staffers and volunteers, Mousepads, Shoe Leather and Hope.

This paper proceeds in three parts. I begin by showing how the technical and organizational practices of many of Dean's Internet Division staffers were guided by the principles of the open source movement. I then turn to the public framing of the Dean campaign as a radical techno-democratic effort, showing how it was discursively linked to narratives of the new economy and participatory democracy. Finally, I turn to the concrete work that this frame performed, showing how it attracted the attention of professional journalists and mobilized supporter labor.

Open Source and Electoral Innovation within a Formal Campaign Organization

Zack Rosen was a sophomore at the University of Illinois Urbana-Champaign in 2003. The twenty-year old computer science major spent many of his days reading about the implications of the Internet in books that ranged from Weinberger's Small Pieces Loosely Joined and Albert-Laszlo Barabási's Linked: The New Science of Networks to Lawrence Lessig's Code and The Future of Ideas. Intrigued by these authors' arguments regarding the transformative effects of the Internet on social life, and in the early stages of a presidential election, Rosen began doing some research into politics. He found an obscure former governor who surprised him:

> I was kind of looking for an avenue to get involved in politics. I hadn't done much political work before and I started to read all these books about the future and the technological implications of the Web and social organizing in general.... At the same time, I started doing political research and I heard about this candidate Dean who was doing all this creative stuff on the Internet.... It was kind of a perfect match. I realized that all the things I was reading about in these books were coming to life in a campaign. And it coalesced a lot of things I was passionate about. (Zack Rosen, personal communication, April 7, 2008)

Soon after this discovery, Rosen reached out to volunteers creating online tools for Dean's effort and launched a mailing list called "Hack4Dean" to coordinate the programming efforts happening entirely independently of the campaign. By July, Rosen had dropped out of college and, with the help of fellow hackers, created a prototype of "Deanspace," a toolkit built on the open source platform Drupal that enabled supporters to set up their own Websites and plan events for Dean. In the months after the launch of Deanspace hundreds of activist sites bloomed including "Music for America," "Seniors for Dean," and "Catholics for Dean."

Rosen's story is extraordinary, but it captures the unprecedented technology-fueled volunteering that lay behind many aspects of the Dean campaign. From mid-2002 on through to the first nominating contests in January 2004, thousands of enterprising hackers, technology entrepreneurs, and political activists developed and used a host of new Internet tools as volunteers for Dean. As they built Websites, commented on blogs, gathered offline using Internet-based tools such as Meetup, and, most importantly, donated small amounts of money that rapidly scaled, their work helped propel a virtually unknown governor from a small New England state into the lead for the Democratic presidential nomination, right up until the Iowa caucuses.

Although the internal workings of the Dean organization have received relatively scant attention in the literature, supporting and coordinating many of these volunteer efforts were staffers within the dynamic and creative Internet Division of the campaign. Under Joe Trippi's direct management, the Internet Division encompassed a diverse group of staffers, but most had technical and professional knowledges from domains outside of electoral politics. For example, many Division staffers were unemployed or underemployed by a slowdown in the technology industry or just seeking new challenges and therefore left the 'new economy' to try their hands at politics. Others were programmers, including many participants in open source development projects. A number were part of a new generation of Internet activists writing blogs and taking online action on behalf of progressive causes. Yet, regardless of their varying paths to the Dean campaign, many of these staffers shared a vision of a new form of technologically-enabled politics. And, to make it a reality, they pieced an amalgam of strategies and ad-hoc problem-solving skills from these commercial, technical, and activist domains. For instance, Nicco Mele (personal communication, July 29, 2008), Dean's Webmaster, argues that the Internet Division of the campaign tied together the political culture of grassroots progressive organizing and "the open source, collaborative world."

As an interpretively flexible concept that carried meaning in disparate social worlds, open source in particular provided a shared language and set of practices for many Internet Division staffers. Indeed, part of what made open source powerful was its ambiguity and lack of formal definition, serving as a "boundary object" (Brown & Duguid, 2001; Knorr-Cetina, 2009; Star and Griesemer, 1989) that offered staffers a shared language to coordinate their efforts while enabling them to interpret it differently in practice according to their needs. As Jerome Armstrong (personal communication, November 21, 2008), a prominent progressive blogger and consultant for the campaign, suggests in relation to staffers' understanding of open source: "nobody in the campaign knew what the hell it meant." Yet, while it was never formally defined, and some had only a vague understanding of technologies such as Linux, open source did signify a collaborative organizational model that was both easily transposed to the political realm and particularly resonant for Dean's progressive staffers who valued democratic participation. As Rosen (personal communication, April 7, 2008), who was hired by the campaign in the fall of 2003, suggests, open source was a model that richly accorded with the campaign's ethos around helping citizens "take their country back," as the ubiquitous slogan proclaimed:

> people really understood bottom-up open source processes. Trippi was very explicit about the open source campaign. He described it acutely. I understood open source

> processes. It really is revolutionary, fundamentally a different way of being effective and getting work done. We all shared the theory that it could carry over to politics and it was proven out. People understood the implications of this.

In this sense, the concept of the open source campaign helped guide these staffers' technical practice. In the process, these figures reconcieved the Internet as an organizational and mobilizational tool, a significant innovation in electoral campaigning. As detailed above, prior to Dean's run candidates largely used their Websites to provide static, html versions of campaign literature.[2] Many of Dean's Internet Division staffers, by contrast, saw the Internet as a tool to facilitate distributed supporter participation in the campaign. Staffers, for instance, drew on the model of open source to provide supporters with resources to organize their communities for Dean and even develop some of the core technical infrastructure of the campaign. In inviting this participation, these staffers helped create a national volunteer effort that broke fundraising records, turned thousands of individuals out at events for Dean, and created novel campaign tools that rivaled even commercial applications such as the early social networking site Friendster.

Many of these supporters, particularly those working on technical projects, in turn saw the campaign, and their roles in it, in terms of open source. For instance, the Internet application Deanspace, the online toolkit built by Rosen and other members of Hack4Dean, was one example of a technology produced by volunteers and utilized by the campaign. These volunteers, and the staffers that embraced and encouraged their work, saw the development of Deanspace and the online application itself as symbolic of the open source ethos of the campaign and, by extension, the candidate. This is suggested by the fact that the Hack4Dean group built Deanspace on the open source Drupal platform in large part because it fit with the perceived 'openness' of the campaign.[3] Indeed, even though other campaigns could adopt this technology given the underlying public source code, volunteers believed that rivals did not have the same open culture of the Dean campaign. As volunteer developer Aldon Hynes (personal communication, April 2, 2008) explains:

> it was important that it [Deanspace] reflect the openness of the campaign. We argued that the Bush campaign could not use it because their culture could not produce the openness. Unlike Dean, Bush was not willing to be open to other people. We believed that there was an underlying deep structure to the technology.

While technical projects such as these received most of the attention in the press and academic literature, the formal campaign organization steered much of the electoral participation of Dean's supporters towards ends long institutionalized in electoral politics.

[2] This was, in part, due to the fact that the legal questions surrounding online campaigning were unsettled. It was only in 1999 – through a petition by George W. Bush to the FEC – that campaigns were allowed to take credit card contributions online. During the 2003-2004 cycle there were a host of other legal questions, but the Dean campaign was willing to test the boundaries of the law. For example, a former staffer of Al Gore and John Edward's Internet teams describes how lawyers for the 2003-2004 Edwards campaign internally debated questions such as the legality of supporters building their own sites for the candidate. The Dean campaign, by contrast, with little to lose as a long-shot candidate simply forged ahead with supporter collaborations, with the philosophy of worrying about the legal issues later (Aaron Myers, personal communication, May 9, 2009)
[3] David Cohn (2007) argues that the Dean campaign served as the point of diffusion in the United States for Drupal after it was used for Deanspace.

Supporters across the country used tools such as Deanspace to organize their neighbors and fundraise for the candidate, which were novel forms of decentralized field and fundraising efforts, yet they had few channels for more substantive forms of participation in the campaign (Haas, 2006; Stromer-Galley and Baker, 2006). This highly delimited form of participation marks an important distinction between the Dean campaign and many open source technical projects. As Weber (2004) notes, large-scale open source technical projects tend to have hierarchical decision-making structures that manage complexity and coordination. Yet, on projects such as Linux all aspects of the code are open to contributions. Even though contributions may be rejected leaders such as Linus Torvalds and his lieutenants, who often hail from the community of programmers around an open source project, must justify decisions and be responsive to participants. In contrast, Dean's supporters lacked meaningful opportunities for 'voice' (Flew, 2009) and had little in the way of channels for expressing their policy views. For example, as I detail below, even the campaign's Internet policy was the work of experts, entirely closed to public participation. In other words, outside of fundraising and electioneering, much of the campaign simply was not open to supporter participation.

That the campaign directed supporter involvement towards fundraising and organizing instead of policy and strategy was the result of the Internet Division being embedded in a formal organizational structure. As I have documented elsewhere (Kreiss 2009a), the Dean campaign adopted a generally recognized, legitimate organizational form to work with other electoral actors such as journalists, political elites, and citizens. Formalized structures helped staffers conduct their activities on a routine basis, tasks such as coordinating field operations, building relationships with the professional press, reporting to governmental agencies, allocating scare resources to third party vendors, and making strategic political decisions about where to deploy volunteers and advertising. Meanwhile, Trippi and consultants for the campaign devised the explicit strategy of developing tools so as to better channel supporter collaboration given the candidate's position as a party insurgent. Dean's outsider status meant that the campaign needed non-elite bases of fiscal and political support. As Jascha Franklin Hodge (personal communication, December 22, 2008), a programmer who worked for a number of start-ups before becoming Dean's National Systems Administrator, explains:

> We had no institutional advantages, not like Kerry or Gephardt. People were just fed up. It was an environment where people could overcome a power base, we just need to figure out how do we get them engaged enough in political process, in local party organizations. How do we insert these people into where we can to have them stand up for Dean?

As such, a formal structure adapted to a competitive electoral environment directed the work of the Internet Division staffers and their supporter collaborators towards particular instrumental ends. For many of these staffers, then, along with providing a model for technical practice the idea of the open source campaign performed "ideological work" that maintained "some semblance of consistency, coherence, and continuity" (Berger, 1981) between the values of these progressive activists and their actual roles in transactional online campaigning. Meanwhile, to overcome Dean's institutional disadvantages, staffers needed to find and create active and engaged citizens. They did so through their cultural work around the open source campaign and networked campaign tools that both fashioned and mobilized supporters. As the next section details, staffers such as Joe Trippi were cultural "entrepreneurs" (Iacono and Kling, 2001) who rhetorically situated the campaign's uptake of digital media for audiences far beyond the Internet Division within discourses of new economy business practices and conceptions of participatory democracy espoused by leftist social movements in ways that garnered resources for Dean's run.

The Dean Campaign, the New Economy, and Participatory Democracy

With Dean's run for the presidency, a remarkable array of new terms entered the political lexicon. While few seasoned political journalists had even heard of Linux or blogs at the start of the primary season, by September 2003 even trade publications such as Campaigns & Elections marveled at the campaign's use of "Meet Up" and quoted Trippi's proclamations that the Dean campaign "isn't top-down organizing; it's really bottom-up" (Mark, 2003). Many journalists interpreted all aspects of the campaign through the lens of the Internet, including casting the campaign as the political analogue of the dot.com firms of the 1990s. And, just as the new economy was supposedly empowering consumers, these journalists suggested, so the Dean campaign was using digital tools to realize the 1960s dream of participatory democracy.

This section shows how Dean's staffers helped conjure up these associations for journalists. Staffers articulated the frame of the open source campaign and situated the campaign's uptake of the Internet within larger narratives of the new economy and participatory democracy. The elements of this cultural assemblage reflect what social movement scholars refer to as the "discursive opportunity structures" during the 2003-2004 primaries, or the "institutionally anchored ways of thinking that provide a gradient of relative political acceptability to specific packages of ideas" (Ferree, 2003, p. 309). For example, as staffers adopted the language of the new economy for Dean's run, they situated the campaign within a set of understandings regarding consumer empowerment and provided a well-established trope for journalistic coverage. Meanwhile, 'participatory democracy' has long served as a powerfully legitimating "master frame" for social movements, particularly for the ideological left (Benford and Snow, 2000, p. 618).

For Dean's staffers, the campaign's uptake of the Internet resembled a host of shifts that pundits and academics argued had come about with the new economy. This was due to the fundamental technological changes that were seemingly revolutionizing much of economic and social life. Trippi (2004, p. 209-210) and other staffers, for instance, argued that the campaign was equivalent to the pioneering business practices of "Amazon.com, eBay, and all the online travel agencies." As such, the campaign resembled the new economy sites where empowered consumers bought, sold, and traded their wares. In other words, the same digital tools that enabled consumers to book their own airline reservations and create auctions for goods without any intermediaries also allowed them as citizens to take democracy into their own hands. For example, Trippi (2004, p. 82) argued that there "are not just markets anymore. They're communities. And we're not just consumers. We're citizens again. We're looking for the companies, politicians, and institutions that will build the best communities."

This cultural link to Silicon Valley in turn enabled journalists to write about the campaign through a well-established story genre: the dot.com start-up. Despite the organizational complexity of the campaign and the political professionals who populated much of it outside the Internet Division, technology and political journalists interpreted nearly all aspects of Dean's run through the lens of a fledgling Silicon Valley firm. For example, in Fast Company Tischler (2003) argued that: "Dean's campaign has all the hallmarks of a startup circa 1997. It's getting big fast. It's monetizing eyeballs." Meanwhile, these characterizations of the campaign did not simply appear in the business and lifestyle magazines of the Valley – publications that paid scant attention to politics during previous electoral cycles. In an expansive profile of the Dean campaign in the New York Times Magazine, Shapiro (2003) describes the Internet Division as looking "a lot like a dot-com start-up from the mid-90's: preternaturally pale-skinned young men, crazy hours and slightly messianic rhetoric." Many journalists, in turn, read the Dean campaign as the electoral application of the technical and business practices of the Valley, in effect legitimating its innovations for a wider audience of citizens and political actors. Citing how Internet theorists such as Weinberger, Doc Searls, and Howard Rheingold consulted for the campaign, Shapiro for instance interpreted the campaign as an extension of the commercial trends that by late 2004 would be called "Web 2.0":

> The latest holy grail of the tech industry is the idea that people can fuse the virtual communities and digital connections of the Internet with real, human life. Investors are pouring money into Web sites and software programs that claim to perform this function, like Friendster, which lets users visually represent their real friend networks online, and Meetup.com, the site that has helped build the Dean campaign (Shapiro, 2003).

These journalistic tropes are evidence of a long and powerful process of "legitimacy exchange" between the campaign and Valley firms and luminaries. As Geof Bowker (1993, p. 116) shows, "legitimacy exchange" involves two or more parties gaining rhetorical legitimacy by mutually referencing one another to validate their claims. The campaign, for instance, legitimated its novel technical practices by pointing to open source projects such as Linux and the empowering of consumers by Valley firms. This was all the more crucial given that Dean's Internet-tools and the sprawling volunteer activities they supported were innovations in electoral practice on a number of levels and thus involved risk and uncertainty. As such, Dean's staffers and advisors referenced Linux and these firms when faced with questions from journalists and political elites regarding the online campaign and whether it would be effective. At the same time, given sagging industry fortunes with the dot.com bust, the Dean campaign's success during the summer months offered the possibility of affirming the Valley's social and business vision as well as its firms and technologies. Luminaries of the industry were quick to promote this. For example, in February 2004 the "O'Reilly Emerging Technology Conference," one of the consummate industry gatherings founded by open source guru and coiner of the phrase 'Web 2.0' Tim O'Reilly, sponsored a co-located "O'Reilly Digital Democracy Teach-In" that brought together many of the key players from the Dean campaign to discuss how "Internet technologies are putting power back into the hands of people." In co-locating these conferences, a material instantiation of the legitimacy exchanged between these two professional worlds throughout the 2003-2004 campaign, O'Reilly invited developers and entrepreneurs, as well as journalists and the public, to imagine a new generation of commercial tools as uniquely democratic.

Meanwhile, in the political register staffers argued that the technologically-empowered Dean campaign realized ideal participatory democratic practices. On one level, appeals to participatory democracy simply referred to the increased opportunities for electoral engagement made possible by Dean's uptake of new technologies. In this sense, the ethos behind open source technical efforts and the practices of collaboration, openness, and sharing central to them fit culturally with ideal conceptions of democracy among Dean's progressive staffers. The language used by staffers to describe the campaign often made this connection explicit. The open source model was, for Trippi, nothing short of the realization of egalitarian democratic forms. Trippi (2004) dedicated his autobiography of the campaign, for instance, "to the six hundred thousand people of Dean for America who relit the flame of participatory democracy." In this sense, the collaborative electoral activities facilitated by networked media reinvigorated participation in democratic life. The candidate himself echoed this, fostering an "Internet-driven populist energy" with speeches intended to inspire a newfound sense of citizen agency: "The biggest lie that people like me tell people like you during the election season is 'If you vote for me, I'll solve all your problems.' The truth is that the power to change this country is in your hands, not mine" (Singer, 2004).

On a deeper level, the conceptions of technology and benefits of mediated citizen engagement espoused by members of the Dean campaign echoed theories of participatory democracy advanced by leftist social movements during the 1960s. While theories of democratic participation have a long history in political thought, the origins of its contemporary formulation lie with the Students for a Democratic Society (SDS). Michigan philosopher Arnold Kaufman first used the specific phrase "participatory democracy" in a 1960 essay where he argued that "its main justifying function is and always has been, not the extent to which it protects or stabilizes a community, but the contribution it can make to the development of human powers of thought, feeling and action" (Kaufman, 1960). While at Michigan Kaufman taught Tom Hayden, SDS president from 1962-1963, and he served as a "free-floating guru" at the famous Port Huron conference in 1962 (Miller, 1992, p. 111). Hayden drafted the Port Huron Statement, the founding document of the era that served as the intellectual cornerstone for what Todd Gitlin (1987, p. 102-103) described as the "metaphysics of participation" among the New Left.

The Port Huron Statement articulated a powerful discourse of democratic participation, its psychological benefits, and its relationship to communication technologies and social forms. With intellectual influences spanning from John Dewey, C. Wright Mills, and Erich Fromm to Kaufman, Hayden was deeply concerned with psychological alienation. Reflecting this, the Port Huron Statement argued that participation in political, social, and economic life would produce "communicative beings" that could overcome their alienation from themselves and their communities (Mansbridge, 1999, p. 312-313). Participation would also help men realize their "potential for self-cultivation, self-direction, self-understanding, and creativity (Miller, 1992, p. 332)." Hayden, in turn, entwined this ideal psychological wholeness with thinking about technology, communications media, and democratic social forms. The activists who met at Port Huron believed that "supertechnology" in the hands of bureaucratic elites was dehumanizing men and fragmenting communities as it created "mass" society, "monster cities," and "mass labor (330)." The way forward for the SDS was through citizen engagement in political, social, and economic affairs using "the media for their common participation" and "by experiments in decentralization, based on the vision of man as master of his machines and his society (364)." This was a society that should be "broken into smaller communities (365)" and arranged to enable "personal links between man and man (332)." It was a vision that called for a humanized form of technology that would enable men to understand machines and integrate them into the conditions necessary for the development of the community and the whole person: "technology, which could be a blessing to society, becomes more and more a sinister threat to humanistic and rational enterprise (342)."

Forty years later, staffers on the Dean campaign channeled many of these sentiments as they crafted their own brand of open source, Internet-empowered politics to forge a technologically-enabled participatory democracy. For many Dean figures, the Internet was both a symbol of ideal democratic forms conceived in much the same terms as the SDS even as it was a tool for realizing this social vision. Dean technology advisor Howard Rheingold, for instance, argued that the Internet inherently had a "decentralized, self-organizing power" that was uniquely democratic, even as it facilitated supporters' use of Meetup to create political "smart mobs" that were "returning power to the people (Skinner, 2004)." Indeed, these figures believed that Internet, by its very design, supported the ability of individuals to take action in political life and challenge elites, political parties, and interest groups. As Trippi (2004, p. 102) argued, "the Internet is tailor-made for a populist, insurgent movement. Its roots in the open-source ARPANET, its hacker culture, and its decentralized, scattered architecture make it difficult for big, establishment candidates, companies, and media to gain control of it." In essence, these figures argued that the Internet was the humanized technology that the SDS was calling for, since it supported a decentralized social order and the communicative links that realize new forms of political power.

At the same time, Trippi and others conceived of many of the benefits of this communicative, mediated political participation in psychological terms. Just as Kaufman and the SDS posited a strong psychological dimension of political participation, so too did Dean figures argue that through the renewed democratic participation made possible by the Internet individuals developed the self and overcame the psychological alienation caused by the much-maligned 'broadcast model' of political communication. For example, Trippi argued that in this new style of Internet politics campaign managers needed to "unleash the power of the people to be creative (Tischer, 2003)." Citizens, in turn, would have the means to act as creative agents of their own participation, joining not only in electoral activities that they themselves plan but expressive forms of communicative engagement given that online everyone can be a media producer. All of which, Trippi and others argued, restored the very foundations of American democracy itself: "America is built from the bottom up - not from the top down. Historically to release this creative energy of the people is to create not a political storm, but tsunami of power, purpose, and patriotism (Trippi and Cadell, 2003)."

This section detailed how Dean's staffers and advisors situated the campaign's uptake of digital tools within larger narratives of the new economy and participatory democracy. While this reveals the broader cultural tributaries to the symbolic work of Dean's campaigners, in the pages that follow I detail how staffers made this frame for the campaign public through a press and public communications strategy. As I show, despite the lack of attention to cultural processes among many scholars of new media and politics, the framing of the campaign as a radical techno-democratic movement was both deliberate and made a significant contribution to the success of the candidate during the summer months.

Going Public and Creating a Movement

In his classic study of the demise of the SDS Gitlin (1980) provided a powerful account of the relationship between professional media and social movement organizations. The framing of the movement in media coverage, and the norms of 'newsworthiness' among professional journalists, not only shaped understandings of the SDS for the public and other political actors, but even for activists themselves. Gitlin argued that SDS members trusted media accounts of the movement more than their own direct experience and adopted a highly performative, mostly symbolic style of protest to garner coverage.

While much of Gitlin's account deals with the baleful consequences of journalists' framing of the SDS, suggesting only the limited potential of activists to shape media narratives and thus public understandings of social movements, this section reveals how SDS's ideological descendants on the Dean campaign harnessed the power of the professional press – at least for a time. I focus here on how Dean's staffers and advisors used rhetorical claims of the open source and technologically-empowered campaign alongside the symbolic deployment of digital tools to drive widespread press interest in and shape public understandings of the campaign. As Zack Exley (personal communication, January 6, 2009), a staffer at MoveOn who consulted for the Dean campaign, argues, for Trippi the Internet "was this huge newshook. You could combine the Internet with any old-fashioned campaign story and the papers would eat it up. And he rode that wave as a media person and as a communications person." This cultural work, meanwhile, translated into significant resources for the campaign, increasing public awareness of Dean's candidacy, changing the perception of the candidate's chances, and assisting with fundraising and recruiting and mobilizing volunteers.

Attempts to shape public understandings of the Dean campaign began and ended with the packaging of Trippi himself as the embodiment of a radically new style of politics ported from open source communities and Silicon Valley. Trippi presented his professional biography to journalists as the key to explaining and understanding the innovations of the Dean campaign. In this sense, Trippi spoke through many press accounts of the campaign, relating how he attended San Jose State University in the 1970s where he began to get involved in politics and had his first experience using ARPANET. While in the intervening years he launched a full-blown political consulting career – often working on behalf of outsider, insurgent Democratic candidates – Trippi told journalists that he always remained fascinated by new communications technologies. So much so that while on hiatus from politics during the 1990s Trippi (2004, p. 54) ended up consulting for what he referred to as "a few brash young companies" including Wave Systems, Smartpaper Networks, and Progeny Linux Systems. Trippi meanwhile argued, and journalists related, that these early experiences with Linux and quintessential dot.com-era startups provided the model for the Dean campaign.

The campaign's uptake of the Internet, which enacted this founding story, served as the focal point for journalistic accounts of the campaign. While it is not surprising that many technology-oriented magazines embraced narratives of the digital campaign, as Table One makes clear even many newspaper political journalists covered Dean's run through through the trope of the campaign's uptake of the Internet.

Table 1: Newspaper articles about the Howard Dean campaign's use of the Internet and total coverage of the campaign January 2003-February 2004

	Internet	Total Articles	Percent of Internet Stories
January 2003	2	173	1%
February	4	143	3%
March	13	113	12%
April	8	145	6%
May	16	186	9%
June	38	205	19%
July	88	374	24%
August	71	376	19%
September	92	692	13%
October	85	539	16%
November	109	745	15%
December	173	1222	14%
January 2004	268	2244	12%
February	255	1391	18%

Notes: Lexis/Nexus database search of twenty-nine major market daily newspapers

That so many journalists covered the campaign in this way was part of the press strategy honed by Trippi. From very early on Internet Division staffers and consultants deliberately and constantly pushed "stories around about what we were doing with the Internet (Jerome Armstrong, personal communication, November 21, 2008)." One reason staffers were so successful at getting these stories in the press was their attention to providing journalists with verifiable metrics of the campaign's online support. For example, as early as mid-March 2003 the campaign hosted a "Million Dollar Meetup Challenge" for Howard Dean that involved supporters adding a penny to their contributions made over the Internet so the campaign – and the press – could determine the source of these funds (Annatopia, 2003). Meetups themselves served as an important metric that journalists used in assessing the early support of primary campaigns, regardless of the fact that many of these gatherings occurred in states without important nominating contests. For example, the press widely reported on the crowds that the tool helped draw to Dean's campaign events. A March 2003 Meetup in New York that drew over 300 supporters to hear the candidate, for instance, launched Dean as the Internet candidate for many journalists. Trippi even made sure the campaign continued to use Meetup as an organizing tool throughout the primaries given that it provided a verifiable metric of online support for journalists, despite the fact that the campaign had developed better event management tools in-house (Zack Exley, personal communication, January 6, 2009).

Nothing attracted the attention of journalists more, however, than the campaign's staging of high-profile public events that dramatically demonstrated its online organizing and fundraising capacity and seemingly embodied the open source campaign. For example, an early and important symbolic victory for the Dean campaign came during the "MoveOn primary". On June 24th and 25th, MoveOn.org (2003), the largest and most powerful progressive online organization, held what it referred to as "the first online primary of the modern age….to determine if there was consensus among MoveOn members for a candidate endorsement for the 2004 presidential contest." For Trippi, this was an important opportunity to demonstrate the campaign's online support – particularly given that it came in advance of the public release of the campaign's second quarter fundraising numbers (which had Dean leading both Kerry and Edwards). As Nicco Mele (personal communication, July 29, 2008), the campaign's Webmaster, explains: "Trippi was very focused, MoveOn became a critical focal point for Trippi and consequently for the whole campaign….the focus was to impress MoveOn, and attract MoveOn's attention, and to win the MoveOn primary. It really just gave focus to the campaign." Trippi not only saw the organizational strength of MoveOn given the 317,647 members who voted, but construed, and subsequently framed, this as a key early metric for political journalists to judge the strength and support of the primary campaigns. Dean won with 43.87% of the vote in a field of nine. While this was short of the 50 percent threshold necessary to win the official endorsement of the organization, the primary received wide coverage. This included a New York Times (2003) editorial that noted the sheer scale of the online primary: "the virtual tally…would top the combined turnouts in Iowa, New Hampshire and South Carolina in 2000."

The campaign followed up its MoveOn primary victory with online fundraising events that both raised significant monies for the campaign and garnered an extraordinary amount of media attention. Journalists followed these events closely given their novelty: even during the summer of the 2003-2004 cycle fundraising online was not well developed as a campaign practice. While the campaign held many fundraising drives, a singular event in July received widespread press coverage and became canonic for many who believed the Internet revolutionized the political process. During a $2,000-a-plate fundraiser hosted by Vice President Dick Cheney the campaign posted a picture of the candidate eating a turkey sandwich on the Dean For America Website. Small donations poured in, and Dean out-raised Cheney by nearly $200,000. While the amount raised was spectacular for online fundraising at the time, as importantly Dean's feat grabbed headlines on political pages throughout the country as awestruck journalists watched the campaign's stunning success in online fundraising. Journalists construed this event as evidence for the innovative, and even revolutionary, nature of the campaign, and it became a cornerstone of subsequent campaign coverage. Furthermore, many journalists remarked on how they even had to change their reporting routines to accord with this new, online campaign (Srupp, 2003).

This press attention, in turn, heightened the visibility of the candidate and the campaign. Part of the power of the idea of the open source campaign, meanwhile, was that it carried meaning in simultaneously technical, commercial, and political registers. As such, the campaign both had wide appeal and supporters from different social and professional communities could imagine their electoral work in diverse ways. The developer volunteering for the Dean campaign, for instance, could see the processes and products of coding as a form of political action. Entrepreneurs could see a powerful demonstration of their profit-generating tools being put towards progressive and, ultimately, democratic ends. Political activists, meanwhile, could invest the often trudging and un-heroic work of politics with the veneer of countercultural computing, becoming the hackers of progressive politics as they used Meetups to organize their communities. All of which helped recruit specialized volunteers from among these constituencies, and constitute a broad-based political movement.

The rhetorical construction of Dean's electoral effort as an open source, techno-democratic movement helped create and mobilize key constituencies that were central to the campaign's early success. Alongside the strategy of garnering general political press coverage for the campaign, for instance, staffers performed symbolic work to attract and motivate the youthful volunteers who could engage in specialized technical labor. For many of these supporters, the appeal of the Dean campaign lay in the larger socio-technical vision Trippi articulated, not just the narrow ends of applying new tools to win the primary. As Streeter and Teachout argue: "part of what made the campaign what it was, what attracted a slew of young Internet enthusiasts and created an iconoclastic sense of openness, an enthusiasm for experimentation, and a new sense of hope, was the way it became associated with the vision of new technology and a widespread fascination with the future (Teachout and Streeter, 2007, p. 28)." In this sense, the campaign's appeal transcended traditional political constituencies, just as staffers such as Rosen (personal communication, April 7, 2008) dropped out of college and joined the campaign to pursue the idea that you could "open source the org process."

On many levels, Internet Division staffers deliberately articulated this vision and crafted their appeals with this technically-skilled community in-mind. For example, the campaign developed a formal policy position in support of open source technologies in order to get covered on Slashdot, the large, collaborative group blog with the tagline "News for Nerds. Stuff That Matters." Technology industry professionals, hackers, and computer enthusiasts, an important potential constituency for the campaign, constituted the core community of SlashDot. As Zephyr Teachout (July 10, 2008), the campaign's Director of Internet Organizing, explained:

> we were using it to get Slashdotted. So, it is actually a story about political strategy, not about policy creation. It was not an open source created policy platform, it was a policy platform about open source…. Half the people who helped write it were wonderful lefty San Francisco technologists on the finance team…. I liked the policy, but this is not a radical democratic moment. Now, the reason it is radical and important, the serious point, is that issues that were otherwise completely off the charts are now suddenly important for lots of people. Because suddenly you are responsive to a new category of donors including the Slashdotters. And so then you care about things that

> you didn't previously care about. Which you wouldn't have cared about if you were just doing high dollar donor stuff.[4]

While this was a transactional relationship for the campaign, for the Slashdot community it was a validation that a major party presidential candidate heard their concerns. As a Slashdotter announced the news: "Regardless if you're for Dean, against Dean, or you're not an American, it's great to see an American politician on the national level using and promoting free software. I wonder if RMS [Richard Matthew Stallman] thought he'd see a U.S. presidential candidate releasing stuff under the GPL when he founded GNU 20 years ago! (Michael, 2003)."

This strategy of appealing to communities on sites such as Slashdot to help garner fiscal and other support for Dean's candidacy, and in the process reinforcing the symbolic validation of the Internet campaign, extended beyond technical communities. Given that the framing of the campaign had simultaneously technical, commercial, and political dimensions, so too did Dean's advisors and staffers symbolically fashion their efforts as a new economy experiment, particularly to legitimate the campaign for political professionals. This is powerfully clear in Trippi's recruiting of David Weinberger, the theorist, columnist, and marketing consultant, to serve as the Senior Internet Advisor for the campaign. Weinberger is the co-author of the popular dot.com business texts The ClueTrain Manifesto and Small Pieces Loosely Joined, books that Trippi made required reading for Internet Division staffers. As Weinberger (personal communication, November 21, 2008) describes it, when they were introduced, Trippi said he was "looking for a surrogate" to represent the campaign on a panel about the Internet and politics in Washington D.C. In this sense, Weinberger brought the cache of the new economy to the campaign, and provided a frame of reference for political elites to understand Dean's new media innovations:

> My understanding is that he wanted presence because it was good for the campaign…part of the presentation of the campaign. Dean was an unknown governor. They wanted whatever publicity and credibility that they could get. So I would go on panels for him.

Trippi also tasked Weinberger (personal communication, November 21, 2008) with "drumming up enthusiasm among some Internet people," particularly those who were among the foremost interpreters of digital technologies and social and economic change. To this end, Weinberger created Dean's "Net Advisory Net" (NAN) – an Internet policy group that included new media superstars such as Howard Rheingold, Lawrence Lessig, and Joi Ito, a prominent venture capitalist, blogger, and authority on the Web. While Dean's collapse in February 2004 abbreviated the NAN's work, it received considerable attention – particularly among bloggers – for the policy positions outlined in Dean's "Statement of Internet Principles." As a policy document, the Statement reflected the Silicon Valley professional and entrepreneurial milieu that the NAN members came from, particularly in the ways that it entangled commercial computing, deregulation, and social change. At the same time,

[4] The specific policy in question was to release the software the campaign was developing under the GNU general public license. This was the Deanspace technology developed by Rosen based on Drupal.

reflecting the fact that open source was only construed in limited, electoral domains, there was no opportunity for public input in the NAN's work.

Staffers and advisers also blended the technical and commercial registers with the more general terms of democratic empowerment, also framing the campaign's uptake of digital tools in terms of traditional social movement activities. As Trippi put it: "when you looked at him [Dean], you were going to think Internet and personal empowerment in the same way you thought Vietnam hero when you looked at John Kerry, or Southern optimism when you looked at John Edwards (Cornfield, 2004)." On one level, this quote reveals how Trippi wanted to fashion Dean into a symbol of the ways the Internet and the open source campaign allowed citizens to engage in political action. On another, Trippi connected personal empowerment to larger narratives of political community. Publicly citing books such as The ClueTrain Manifesto alongside Robert Putnam's Bowling Alone and Benjamin Barber's Strong Democracy as the inspiration for the Dean campaign, Trippi argued that the Internet enabled citizens to overcome their alienation from the democratic process and band together to create new forms of political association.

In framing the campaign in this way, Trippi strove to mobilize and motivate those supporters for whom the Internet and blogs were more tools for deeper engagement in the political process than revolutionary and transformative forces reshaping society. To this end, staffers integrated the rhetoric of empowerment into nearly all the campaign's communications with supporters. For example, Dean's Internet Division developed the insights of MoveOn to pioneer the genre of electoral emails – establishing a style that the Obama campaign subsequently adopted. As Kelly Nuxoll (personal communication, November 19, 2008), the e-mail manager for the campaign, describes, in communication with supporters the campaign's style was to "never say 'our' campaign; say 'your' campaign." Staffers used these rhetorical techniques to describe how supporters had ownership over the campaign while calling on them to take specific forms of action. This was especially so for Trippi, who was like a "muezzin" in his inspirational messages to supporters, particularly during fundraising appeals. As importantly, staffers adopted a personal style of address, signing their own names to emails, to mask the mass-ness of this communication. In doing so, these individuals attempted to create and foster feelings of intimacy toward the campaign among supporters and increase the likelihood they would become and remain involved. Thus, while e-mail communication was only one-way and thousands of people received the same message on a regular basis, even a former staffer to Vice President Gore confessed that:

> "We had a fabulous Web page, but basically it just sat there…We had a big e-mail network, but there wasn't the real kind of segmentation that you would need to personalize e-mails and to make people feel like they were receiving something special from the campaign." Conversely, with Dean's campaign…"I feel like I have a personal relationship with Joe Trippi (Mack, 2004)."

At the same time, staffers encouraged supporters to imagine they were participating in a revival of participatory democracy as they used the campaign's Internet tools. The candidate himself proclaimed that "we are the great grassroots campaign of the modern era, made of mouse pads, shoe leather and hope (Cone, 2003)." In the process, Dean cast Internet-supported political action as an extension of earlier campaign tactics, such as wearing down shoe leather going door to door for candidates. Meanwhile, supporters responded by donating money online, commenting on blogs, and using Meetup to organize their communities. For example, leveraging the power of MeetUp, the campaign turned out over 138,000 volunteers at 820 locations nationwide to work for the candidate on November 4th, well in advance of any primary. All of which translated into incredible supporter engagement in the campaign – and deep feelings of ownership and collective identity that translated into active and ongoing support.

Conclusion

Dean's star rose throughout the summer of 2003, culminating in a $200,000 ten-city, four-day "Sleepless Summer Tour." This was the high point of the campaign, when Dean's nomination looked likely to even the most jaded political professionals. In grand style, Dean flew the "Grassroots Express" to states that were only important in the general election. At stops along the tour journalists marveled at the "staggering, seemingly spontaneous crowds" (Wilgoren, 2003) and, above all, the power of the Internet that seemingly made it all possible. That was the high point of the campaign. As the improbable frontrunner throughout the fall and winter, Dean was a target for his rivals and the press. Dean made their job easier with a series of gaffes, and the campaign ended up losing control of the press narrative Trippi had so assiduously cultivated.

These missteps were, perhaps, minor compared to what many staffers roundly described as a larger breakdown in the campaign's management at all levels. One significant failure was the on-the-ground field effort in the crucial state of Iowa. In the days before the caucuses the campaign devoted much of its resources to massive television advertising outlays that many supporters and campaign hands alike described as ineffective, and which nearly bankrupted the campaign. However, this may have been the only option left to the campaign at that point. Ironically, for all the vaunted Internet-based applications, field staffers lacked very basic tools for getting out the vote. As Adam Mordecai (personal communication, January 23, 2008), an Iowa field staffer, describes it: "Field operations were a total disaster on the technology front." The unique challenges Iowa poses for presidential campaigns, with its complicated caucus process and deeply entrenched local traditions, only exacerbated the situation. The campaign had no 'precinct captains' in half of the Iowa districts and only an outdated list of volunteers who had signed up online. With few local volunteers, the campaign drew on its significant national support on college campuses, in urban areas, and on the coasts in a last ditch "perfect storm" effort, sending 3,500 mostly out of state volunteers into Iowa wearing orange hats. The strategy was flawed on a number of levels. Not only do Iowans expect local volunteers to contact them, the campaign lacked the basic infrastructure to manage and deploy these volunteers. Dean placed third in the caucuses, and weeks later he withdrew from the nomination race.

While Dean's downfall suggests that the campaign's technical and organizational innovations did not translate into electoral success, they were hardly insignificant. Drawing on models of open source technical production, Dean's Internet Division staffers used the Internet as an organizational tool, decentralizing much fundraising, voter outreach, and even technical development for the first time in a political campaign. Inspired by the collaborative ideals of the open source movement, and provided with an organizational space for innovation given the need to find resources for the outsider candidate, these staffers built and deployed a new set of digital campaign tools that enabled supporters to participate in these tasks. As such, the Dean campaign reveals how open source provides a set of value-laden practices that can be incorporated into domains far afield of technical projects such as Linux.

And yet, even as open source guided the internal organizational practices of many of Dean's technically-skilled staffers, it was also a cultural resource that staffers deployed instrumentally outside of the campaign for electoral gain. Articulated within narratives of the new economy and participatory democracy, the framing of Dean's campaign as an open source and radically techno-democratic movement provided an interpretative framework for journalists to understand Dean's run. It legitimated many of the campaign's innovations, while attracting an extraordinary amount of press coverage. Framing the campaign's uptake of the Internet in technical, commercial, and political registers also appealed to multiple constituencies, helping the campaign attract and motivate supporters to perform high-end technical labor, donate money, and talk to voters. And yet, even as symbolic work around the Internet helped the campaign garner resources and become the center of the political world, it may also have led Dean away from the nomination. As Jascha Franklin Hodge (personal communication, December 22, 2008), Dean's National Systems Administrator and co-founder of the firm that provided much of the online infrastructure for Obama's campaign, argues:

> there was a bit of a bubble in which a lot of the online volunteers operated.…The movement became self-referential to a degree that was probably not healthy for any movement. People became so enamored with the idea of what it was that they were doing that they sometimes lost the macro-political perspective that is necessary to actually get out there and win.

As Hodge suggests, to the extent that staffers and volunteers understood and experienced their online work for Dean as a transformative new way of practicing politics, it may have distracted from necessary and difficult on-the-ground electoral activities. This, in turn, suggests how open source can work ideologically to elide dynamics of power in collaborative, networked forms of organization. While supporters imagined their participation in backend electoral tasks as their taking part in a radically democratic movement fueling Dean's run, it became painfully clear after Iowa that the formal campaign organization maintained authority over the key strategy, allocative, and management decisions that ultimately determined Dean's electoral prospects.

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Free, Open Source Software Advocacy as a Social Justice Movement: The Discourse of Digital Rights in the 21st Century

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Abstract

This essay argues that free, open source software (FOSS) advocacy can be increasingly characterized as a broader movement for social justice. Utilizing the concept of social movements from political sociology, I track the emergence and development of FOSS efforts such as the GNU/Linux operating system and the GNU Public License (GPL), noting that advocacy of open source software has expanded beyond the relatively small community of software programmers to encompass a larger group of non-expert users and related-organizations. Second, the interests of FOSS advocates have begun to merge and overlap with the interests of the free culture/digital commons advocates in the past half decade, with increasing cross-fertilization across these two groups. These issues more closely align the current aims of FOSS with more free culture and digital rights initiatives, suggesting the emergence of a larger umbrella movement for cultural and software freedom on the horizon.

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The Internet Age has brought with it unprecedented access to textual, audio, and audiovisual information via networked computers. While computer software manufacturers and traditional media corporations profited tremendously from these new technologies, they almost immediately began forms of legal pushback against rear-guard actions by consumers who attempted to expand the availability of this information in ways that threatened copyright and other forms of intellectual property. The initial rise of distribution software such as Napster and Gnutella in the late 1990's, for instance, allowed consumers to freely distribute copyrighted music and posed a major threat to the recorded music industry before they were ultimately disbanded or transformed into legitimate music sellers as a result of court action. These initial battles between computer or audiovisual media companies and consumers were symptomatic of the challenges to traditional notions of intellectual property in an era of digitalization and media convergence.

In the shadow of these high-profile battles over information distribution via computer networks, a small group of dedicated computer programmers and technology enthusiasts have been expanding the limitations of proprietary information systems by rewriting those systems to fit their own needs. Beneath the radar of the mainstream media in the pages of technology-oriented periodicals, online blogs, and Internet chat rooms, a group of libertarian-minded programmers have joined a debate about how to short-circuit the rising tide of closed, proprietary computer code which administers the functions of computers and their interactions in cyberspace (Lessig, 2000). The free, open source software (FOSS) movement has countered the computer market dominance of corporations like Microsoft and Apple by developing and/or encouraging the distribution of alternatives to these closed systems. Some of the most successful efforts of this movement have been a rival computer operating system (Linux) and other open source software alternatives that are distributed freely over the Internet.

This essay provides a brief overview of the FOSS movement, focusing specially on the development of the GNU/Linux operating system in the 1990's and the creation of a new copyright regime to prevent the privatization and corporatization of this new operating system. I argue that a number of indicators point to the emergence of a social movement surrounding free, open source software advocacy. First, advocacy of open source software has expanded beyond the relatively small community of software programmers (or "hackers") who are intimately familiar with the UNIX and other programming languages to encompass a larger group of non-expert users and related-organizations. Second, the interests of FOSS advocates have begun to merge and overlap with the interests of the free culture/digital commons advocates in the past half decade, with increasing cross-fertilization across these two groups. While posing a direct challenge to existing copyright regimes through its emphasis on the commons, open source software development also marks a profound shift away from the dominant mode of capital accumulation points toward new modes of cultural production that emphasize collaboration and communal property ownership. The production of this software by "hackers" – individuals who write computer programs and other code and who are outsiders to institutionalized and corporatized forms of software production – also offers a glimpse into a new form of cultural production which exists outside of the boundaries of the wage labor system.

Finally, the initial impetus for the free software movement – preserving the ability of end users to modify and redistribute computer software to suit their individual needs – has shifted to encompass a wider array of issues such as free speech and digital commons advocacy. These issues more closely align the current aims of FOSS with more free culture and digital rights initiatives, suggesting the emergence of a larger umbrella movement for cultural and software freedom on the horizon. While I will argue that FOSS advocacy can be regarded as a social justice movement, it should be acknowledged that the identity of this emerging movement is still in flux and there are a number of actors and organizations whose interests in FOSS and in digital freedom in general either overlap or at times conflict.

Defining Movements for Social Justice

This essay makes two, inter-related claims: first, that FOSS is a social movement and, second, that this movement can be broadly identified as a movement centered aroung core social justice issues. The definitions of these two core concepts will be briefly explored in order to lay the groundwork for the later discussion of the FOSS movement and its links with social justice values. There is a vast body of theory and research into social movements within political sociology, which has approached the definition of social movements from a number of different perspectives (Diani, 2000, p. 157). Turner and Killian (1957, p. 223), for instance, conceptualized social movements broadly as "a collectivity acting with some continuity to promote or resist a change in the society or organization of which it is a part." This definition accounted for the presence of "movement organizations" but was not necessarily synonymous with them (in other words, social movements can exist and thrive without existing bureaucratic organizations to represent their interests or support their goals). A second, highly influential strand in theorizing social movements called "Resource Mobilization Theory" (RMT) focused similar attention on social collectivities, but emphasized the special role of organizations and their importance in securing resources for the perpetuation of social movements (McCarthy & Zald, 1977; Zald & McCarthy, 2002).

While each of these conceptualizations of social movements places a slightly different emphasis on the construction and maintenance of these movements, they all share these fundamental components: collective or joint action; change-oriented goals (or the expression of these goals at the very least); some degree of organization or non-institutional collective action; and some degree of "temporal continuity" (Snow, Soule, & Kriesi, 2004, p. 6). For the purposes of discussion the FOSS movement, therefore, the following definition will be used:

> "Social movements can be thought of as *collectivities acting with some degree of organization and continuity outside of institutional or organizational channels for the purpose of challenging or defending extant authority, whether it is institutionally or culturally based, in the group, organization, society, culture, or world order of which they are a part*" (Snow et al., 2004, p. 11; Emphasis in original).

This conceptualization of social movements is broad and inclusive, referring to collectivities that are both highly bureaucratized and also more anarchic and diffuse. The FOSS movement is more on the diffuse end of the spectrum in terms of its organization, but it satisfies one of the primary criteria of Snow, et. al.'s definition: it poses a challenge to "extant authority". In the case of FOSS, as I will demonstrate below, the authority in question is represented by the corporatization of proprietary computer software along with the restrictive copyright regimes which perpetuate these closed-source software projects.

A number of social movement scholars have further specified the processes by which social movements are created and sustained over time, citing not only access to material resources (such as labor, capital, and communication links) but also the types of ideas which serve to define and mobilize these movements (Benford & Snow, 2000; Gamson, Croteau, Hoynes, & Sasson, 1992; Snow, 2004; Snow & Benford, 1988). This "framing" perspective

> views movements as signifying agents engaged in the production and maintenance of meaning for protagonists, antagonists, and bystanders. Like local governments, the state, representatives of the authority structures, the media, and interested publics, social movements are regarded as being embroiled in 'the politics of signification'" (Snow, 2004, p. 384).

Framing describes the process by which actors in a social movement "assign meaning to and interpret relevant events and conditions in ways that are intended to mobilize political adherents and constituents, to garner bystander support, and to mobilize antagonists" (Snow & Benford, 1988, p. 198). The public articulation of these "collective action frames", argues Snow (2004), can have a transformative effect for a social movement in the sense that it defines the meaning of the movement for both insiders and outsiders, thereby providing the movement with a sense of identity and group cohesion. Framing directs scholars' attention not only to the internal discourses among members of social movements about their own activities and motivations, but also to the rhetoric in the media about these movements. In fact, as the case of FOSS will demonstrate, attracting the attention of the press is often a critical strategy for social movements to gain traction and achieve their goals, though inexperience and naivete when dealing with the media can sometimes backfire and hurt the movement's image and viability (see Gitlin, 2003 for a powerful example of this).

Movements for social justice operate as a particular subset of the types of social movements described above. What distinguishes these movements from other types of single-issue ones is that they adhere to a set of broad principles that result in a diversity of causes and missions. In general, social justice refers to a broad-based cultural, political, and economic egalitarianism with a redistributive urge as its ideological centerpiece. Liberal philosopher John Rawls' two-pronged definition of justice provides the conceptual foundation for modern notions of social justice. Rawls (1999, p. 48) argued in 1951 that the concept of justice required the satisfaction of two basic principles:

> First, each person participating in a practice, or affected by it, has an equal right to the most extensive liberty compatible with a like liberty for all; and second, inequalities are arbitrary unless it is reasonable to expect that they will work out for everyone's advantage, and provided the positions and offices to which they attach, or from which they may be gained, are open to all. These principles express justice as a complex of three ideas: liberty, equality, and reward for services contributing to the common good.

The overriding notion here is that justice is defined by the greatest possible equality for each individual person, which can only be trumped when the a greater common good is achieved. Building upon this notion of justice, Bradley (1996, p. 373) describes *social* justice as "the directing and shaping of society's laws and institutions (e.g., the economy, medical care, social systems, unemployment insurance, etc.) to achieve an equal level of fairness and just treatment for all members of society; a system in which just conduct within a society toward all members of that society is guided by moral principles of truth, reason, justice and fairness." As I will argue below, the increasing encroachment of digital copyright and the anti-competitive nature of proprietary vendor lock-in strategies in the software market work against these social justice aims and have become the targets of FOSS activism for change.

FOSS "Hacktivism" and Technological Social Movements

There is a small but growing corpus of research on technology-centered social movements, including FOSS movements. For instance, Dorothy Kidd (2003) has chronicled the development of Indymedia.org, a website which operates as a digital commons and source of alternative media coverage of events that are important to progressive causes such as environmental reform and anti-globalization (see also Van Aelst & Walgrave, 2004). Similarly, other scholars have noted the efforts of advocacy groups to utilize technology in order to thwart the goals of post-industrial capitalism (Witheford, 1997; Wright, 2004).

These are, of course, examples of technology use among advocates and social movements to achieve non-technological aims: to expand awareness of social issues, to galvanize the public for action, and to affect change. The case for FOSS as a social movement exemplar has been muted by the work of several scholars who have studied specific FOSS communities and found them to be mostly apolitical in the traditional sense (Coleman, 2004; Weber, 2004). More specifically, open source software developers and hackers are chiefly interested in utilitarianism – making sure that the technology is freely available and able to be altered to suit their own individual needs and desires (Raymond, 2001), irrespective of larger debates about intellectual property rights or freedom of speech. That the broader FOSS movement is not necessarily "political" in nature (in other words, closely involved with electoral politics or grassroots political organizing), at least in the United States, does not negate its presence as a force on issues such as digital software rights and digital commons advovacy.

In fact, a number of scholars who have conducted in-depth observational analyses of FOSS communities have discovered myraid ways in which these collectives have become politically mobilized. Perhaps the most pervasive politicized aspect of FOSS collectives is simply what we might term "FOSS evangelism" - encouraging individuals, organizations, and governments to adopt open source software alternatives. McInerney (2009), for example, cataloged the development and expansion of the "circuit riders", a group of politically progressive computer enthusiasts who in 1996 began offering technology expertise and consulting to nonprofit grantees of the W. Alton Jones Foundation. As McInerney (2009, p. 214) writes, these "circuit riders bring F/OSS into their field-level politics by making claims on behalf of the software platform, associating certain ideals of the open source platform with certain ideals of the nonprofit sector." Likewise, Hess (2005) concluded that the open source movement worked toward a wholesale shift in property ownership from private-sector firms to non-profit and public sector entities.

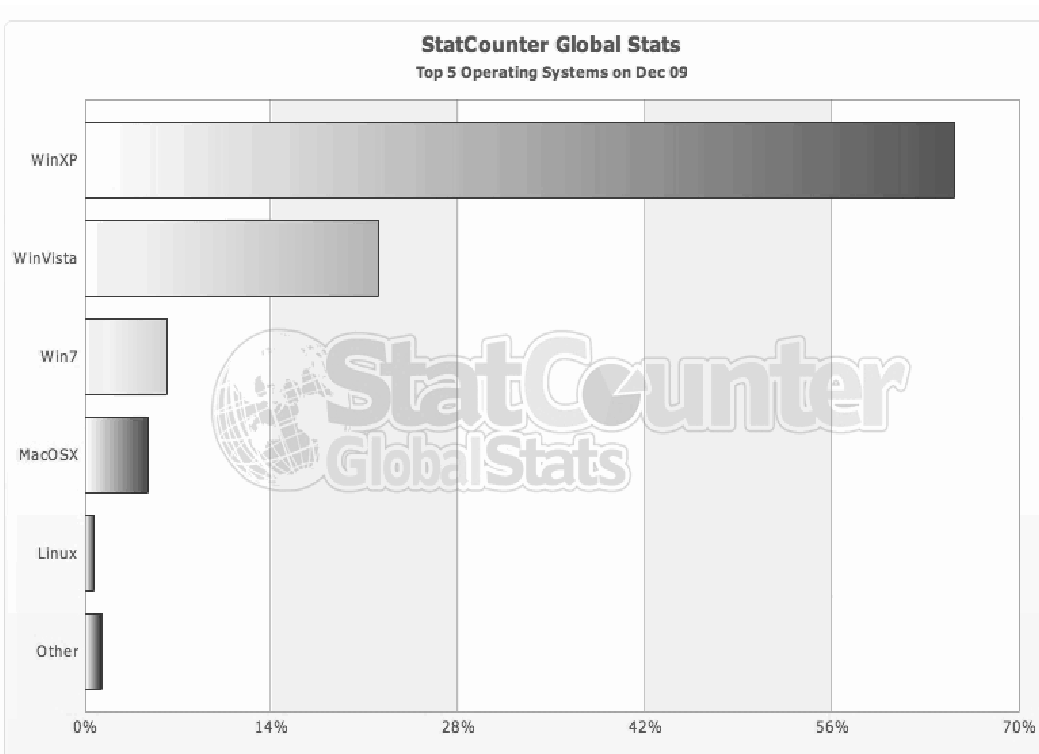
Some scholars have investigated FOSS communities as labor forces, emphasizing their distinction from traditional wage-labor theories of value and potential for radically altering the balance of power between capital and intellectual labor (Banks & Humphreys, 2008; Dafermos & Söderberg, 2009; Söderberg, 2008). Similarly, though from the perspective of economic analysis, others have noted the unique "networked" characteristics of FOSS labor practices, which has institutionalized new, decentralized forms of value creation that are more strategically nimble and ultimately more innovative than traditional institutionalized forms of capital creation (Benkler, 2006; Von Hippel, 2005, 2009).

The Problem: Proprietary Software, Bundling, and Vendor Lock-In

Most computer users today regularly utilize proprietary software to help operate those computers and perform a myriad number of useful tasks with them. Most of the world's computers run some version of the Windows operating system (see Figure 1 below), with a much smaller percentage running Apple's Mac OS X operating system. Linux, the open source alternative to these operating systems, makes up only a tiny fraction of the overall total. Microsoft's dominant position in the industry is not necessarily a sign of the popularity of its information products – in fact, Microsoft's Windows Vista operating system has been much maligned in the popular press, becoming a kind of corporate albatross which the company hopes to remedy with the most recent release of Windows 7 in 2009. The factors most responsible for the ubiquity of proprietary software have to do with the outsized influence the companies that manufacture this software enjoy and their close ties with other market players to effectively "bind" the software together in packages for sale to consumers. For instance, the Windows operating system is often the default operating system included on new computers that are sold to consumers because of pre-existing business relationships between Microsoft and computer hardware manufacturers like Hewlett-Packard and Dell. Along with this operating system bundling, Microsoft bundles its own internet browser (called Internet Explorer) in the operating system itself, thereby encouraging end users to utilize this browser by default when they start up the computer for the first time.

This practice is potentially harmful to consumers because it denies them the opportunity to decide whether or not to purchase a specific operating system or software package, and it makes the potential cost of changing to another software application more difficult because of potential incompatibilities with other types of software. Moreover, deals between companies to bundle materials for the customer can thwart market competition, because the choice of which product to purchase is taken out of the hands of the consumer and placed in the hands of the companies making cooperative arrangements in advance of manufacturing and distribution to the market. Since so few end users actually modify the default settings of their computers, these actions by technology firms may constitute a *de facto* form of regulation (Shah & Sandvig, 2008). This last problem was one of the major anti-competitive practices which resulted in the U.S. Department of Justice's investigation of Microsoft in the late 1990's (McGowan, 2005)

Figure 1. Operating System Use in 2009.



The proprietary model of bundling software and hardware applications together for sale to consumers has begun to extend far beyond the computer industries into other media industries as well. Faced with dwindling audience share for mainstream media outlets like broadcast and cable television, as well as broadcast radio, media corporations have turned increasingly to the Internet to try to re-connect with past audiences and to colonize new ones. The problem faced by these companies is that they have had to compete with the sheer enormity of offerings available on the Web, many of which have been created by other Internet users. Easy distribution of copyrighted content via peer-to-peer file sharing also makes the Internet a somewhat unlikely partner for traditional media firms. The solution media conglomerates have found for the convergence and digitalization of copyrighted content is to slowly absorb important distribution channels on the Internet and then begin to exert control over the kinds of information that are found there. This has already happened with the popular video-sharing website YouTube, for instance, which was purchased by new media giant Google, and MySpace, which was purchased by Rupert Murdoch's News Corporation. The consequence of these moves is the artificial fencing off of separate, proprietary realms on the Internet and through software programs that are increasingly necessary to productively interface with the Internet.

This effort of media companies to create these artificial barriers has been likened to a "second enclosure movement," referring to the practice of taking public lands and handing them to private interests for commercial exploitation (Boyle, 2008, p. 45). This first "enclosure" movement occurred during the emergence of capitalism in feudal Europe, resulting in

> the transformation of the European agricultural system from production for use to production for exchange...Throughout Europe, the mercantilist states enacted laws privatizing the village commons and depriving the peasantry if its means of subsistence, forcing many into wage labor. The enclosures movement, therefore, involved tendencies that brought both land and labor into the realm of commodity production. (Bettig, 1997, p. 138)

The goal of restricting access to hitherto public lands was twofold: to amass surplus production for the purposes of exchange and to create incentives for wealthy landowners to invest in new aqueducts and irrigation systems in order to maximize the productive potential of these lands. The artificial creation of private property was intended to ward off the so-called "tragedy of the commons," in which lands left to the common interest would lie fallow and under-utilized (thereby endangering the full economic potential of such lands) (Boyle, 2003).

The "second" enclosure of information materials a trend that has deep historical roots, tracing all the way back to the invention of the printing press, when monarchs began granting exclusive licenses to printers for specific types of documents, often appropriating as proprietary certain plays, poems, and songs that had been popularly available (Bettig, 1992; Eisenstein, 1979) This shift – defining information and intellectual products as property akin to land – became the core of English copyright law, which was transferred to the American colonies in the 1800's. More recently, the reach of copyright was extended to computer software in the Computer Software Act of 1980, which characterized computer source code as "a form of writing" and thereby subject to intellectual property protections (M. E. Johnson, 1994). This law opened the floodgates for the enclosure of computer programming during the deregulatory zeal of the 1980's. Writing in his 1981 book *Who Knows*, critical scholar Herbert Schiller expressed alarm at the enormous sums of taxpayer funds which were poured into research and development in areas such as microcomputing and nuclear power, only to see the outcomes of those project immediately transferred to the private sphere. These public investments, spurred by Cold War fears, became the private intellectual property of Fortune 500 corporations and deprived the public of the benefits of these government-funded programs. In Schiller's (1981, p. 56) words, "The private attack is characterized by an insistence that information is a commodity and that those who wish to use it should pay for it." In the 1990's, the equation of computer software with intellectual property had become so ingrained in the legal and political discourse that protecting copyrighted material over the Internet emerged as one of the major cornerstones of efforts such as the Clinton Administration's National Information Infrastructure (NII) (Bettig, 1997)

While the rigorous protection of intellectual property may have spurred new innovations in technology, there are numerous potential dangers here for democratic citizenship, the most glaring of which is freedom of speech:

> As culture increasingly becomes fenced off and privatized, it becomes all the more important for us to be able to comment on the images, ideas, and words that saturate us on a daily basis—without worrying about an expensive, though meritless, lawsuit. The right to express one's views is what makes these "copy fights" first and foremost a free-speech issue. Unfortunately, many intellectual-property owners and lawyers see

copyright only as an economic issue (McLeod, 2005, p. 8)

There are numerous recent examples in which the types of "copy fights" that McLeod mentions have boiled over onto the pages of the mainstream media. For instance, users of the Amazon.com's e-book reader, The Kindle, were outraged in July 2009 when the company surreptitiously deleted copies of books that users had already purchased due to a disputed licensing agreement with the estate of the author (B. Johnson, 2009; Stone, 2009). In this case, digital content that end users believed that they owned was re-claimed and deleted by Amazon. This copyright tussle was fraught with ironic overtones because the titles that were deleted from users' Kindles were books by George Orwell such as *1984* and *Animal Farm*. Although the company subsequently apologized and agreed to restore the books to readers' Kindle devices, the incident vividly demonstrated the pitfalls of vendor lock-in for the digital distribution of media content. Apple's iTunes software and proprietary audio encoding codec (AAC) also exemplifies an attempt to lock users into a particular content delivery system: Apple's iTunes store. Even though other hardware manufacturers such as Palm have attempted to link their hardware devices (such as the Palm Pre smartphone) to Apple's iTunes, Apple's has continually modified its software through updates to prevent this linkage, thereby protecting the locked-in nature of the software and hardware ecosystem which is a key profit center for the company (Ganapati, 2009). These are but a few examples of issues of information control and copyright protection that have proprietary software is designed to support. What alternatives, if any, exist to these closed information ecosystems?

What is Free, Open Source Software?

Despite of the growing popularity of free, open source software in the last 15 years as viable alternatives to proprietary programs, the concept of open source is unfamiliar to most. What I mean by "free, open source software" is software that reveals its source code to the user. Software source code is computer programming language that any experienced user can read and understand, and therefore also manipulate and change. Much of the computer software on the market today, including widely-used productivity software such as the Microsoft Office suite and operating systems such as Windows and Mac OS X are closed or proprietary software – they do not allow end users to modify the programs to improve them or personalize their uses (indeed, this is also strictly forbidden in the software's "End User License Agreement", or EULA). The notion of free software originated with an MIT computer programmer Richard Stallman (or RMS, the initials of his name which formed his login password to the MIT computer systems). Stallman had been working at MIT during the formative years of the 1970's, when other computer programmers or "hackers" were experimenting heavily with Unix-based systems and developing software tools which were passed around among users, who admired the skill in writing the code and suggested further improvements (Levy, 1984). Although the term "hacker" has become something of a pejorative, referring to dangerous individual who break into secure computer systems in order to steal valuable data, its "old" meaning from the 1970's and 1980's was quite a positive one, referring to a technologically savvy, intelligent individual who worked against a centralized authority and the rigid enforcement of property boundaries (Coleman & Golub, 2008) As Nissenbaum explains about the early hacker movement,

> If there is something political that ties together these descendents of early hackers, it is protest – protest against encroaching systems of total order where control is complete, and dissent is dangerous. These hackers defy the tendencies of established powers to overreach and exploit without accountability. With their specialized skills, they resist private enclosure and work to preserve open and popular access to online resources, which they consider a boon to humanity. Ornery and irreverent, they represent a degree of freedom, an escape hatch from a system that threatens to become overbearing. (2004, p. 212)

Stallman and other programmers at MIT embodied these anti-authoritarian and communitarian ideals in the work that they performed on the university' computer systems. Each time one programmer came up with a useful program (or "hack"), it was quickly distributed to others who would read and admire the code, and then promptly altered it to create new software programs that fulfilled another utilitarian need.

The camaraderie and communitarian ethos at the MIT lab began to unravel, however, when the U.S. Department of Defense became interested in utilizing these projects to develop its own applications, insisting that these software projects become closed to outsiders to protect national security. Additionally, private companies became less interested in sharing their source code with university programmers and computer science students since new business models for software were emerging, and many of the best minds at these universities were being hired by these firms (one of which was Bill Gates' fledgling startup company called Microsoft).

Stallman worked to preserve the "hacker ethic" he had once experienced at MIT by resigning his position there in 1984 and devoting himself to the advocacy of what he called "free software". Stallman founded the Free Software Foundation (FSF) as a non-profit organization which would be able to support the development of free software projects. Free software, according to Stallman's vision and the tenets of the Free Software Foundation, is comprised of four essential freedoms (Free Software Foundation, 2009a):

- The freedom to run the program, for any purpose (freedom 0).
- The freedom to study how the program works, and change it to make it do what you wish (freedom 1). Access to the source code is a precondition for this.
- The freedom to redistribute copies so you can help your neighbor (freedom 2).
- The freedom to improve the program, and release your improvements (and modified versions in general) to the public, so that the whole community benefits (freedom 3). Access to the source code is a precondition for this.

In essence, then, free software allows users to run, copy, distribute, and change or improve existing software without being prevented from doing so by the originator of the software. This does not mean, however, that financial transactions are anathema to the free software movement: in Stallman's words, "free" simply meant free as in free speech, not as in free beer. In fact, some of the earliest businesses to be created around open source software offered technical support for these tools; something which Stallman himself strongly supported. While software companies sometimes charge users money to download and install open source software, most free software projects today are distributed without cost to users on the Internet, which makes them particularly attractive to computer users in developing countries with few financial resources to spend on computer software.

The primary distinction between proprietary software development and that of volunteer, networked hackers has been beautifully explained by hacker activist Eric S. Raymond as the distinction between "cathedrals" and "bazaars" (2001). Raymond argued that proprietary software is designed from the top-down to meet a specific set of goal identified by a few senior managers or organizational figureheads, with the only involvement from the public or market emerging when the information product has been fully completed. This is the cathedral model. In contrast, open source hacker communities offer an organizational model more akin to a bazaar, where individual programmers work simultaneously on different, and sometimes interrelated, projects with little or no supervision or input from any centralized authority. Often, programmers are motivated to write pieces of software code to satisfy a particular need of the moment, such as allowing a specific peripheral device such as a printer or scanner to work with another type of operating software. The quality of the finished product is then judged collectively by the hackers who download and use the software, who then may in turn offer suggestions, file bug reports, or even improve on the code themselves and upload the results of their efforts for other hackers to see. Raymond's notion of the bazaar suggests that the more programmers choose to work on software code and improve it, the better the ultimate quality of the code will be (and the quicker it will be debugged).

Participation in open source software projects, therefore, is voluntary. In his overview of the sociology of the open source movement, Weber (2004, p. 62) notes that "the key element of the open source process, as an ideal type, is voluntary participation and voluntary selection of tasks. Anyone can join an open source project, and anyone can leave at any time....There is no consciously organized or enforced division of labor." Voluntary participation, however, does not mean that open source projects are anarchic and aimless. Instead, many open source projects work continuously and often swiftly toward a common set of goals and purposes that are mutually agreed upon by the project participants.[1]

Stallman's orientation to free software was about more than preserving the collaborative atmosphere among computer scientists at MIT. Instead, his definition of free software outlined the philosophical underpinnings of a larger social movement to transform the tools which were to become vital conduits of commerce, information, and artistic expression. As Weber (2004, p. 47) describes:

> Software for [Stallman] was not just a tool to run computers. It ultimately was a manifestation of human creativity and expression...Traditional, exclusionary property

1 The exact nature of collaboration among open source software developers is the subject of a good deal of sociological work. The form of these collaborations range widely from loose adhocrasies to sophisticated democratic projects (such as Debian) with mutually-agreed upon rules for development of software. Finally, some open source projects, like the development of the Linux kernel, are essentially benign dictatorships in that they are controlled centrally by a single developer (in this case, Linux founder Linus Torvalds) who personally selects each and every individual who contributes to the development of the project.

> rights do not incentivize people to write good software, as mainstream intellectual property rights law would have it. Rather, imposing traditional property rights on software makes 'pirates' out of neighbors who want to help each other.

Stallman's notion here is that digitized information and computer software is not simply utilitarian but is instead an outgrowth of the creative capacities of human beings. Additionally, as social creatures, it is part of our inherent nature to form collectives and to cooperate. These fundamental aspects of the human experience, however, have been artificially curtailed by the restrictive code that is inserted into proprietary software, making "pirates" out of "neighbors".

Stallman's emphasis on re-invigorating a sense of common good via artistic and other cultural expression has become the philosophical foundation for the larger "free culture" movement. Indeed, Lawrence Lessig (2004), one of the most visible proponents of the free culture movement, credits Stallman as the primary inspiration for his concept of free culture. In a passage which directly channels Stallman's thinkings, he writes: "The opposite of a free culture is a permission culture' — a culture in which creators get to create only with the permission of the powerful, or of creators from the past" (Lessig, 2004, p. xiv). Likewise, some scholars have associated Stallman's exhortation to retain access to computer source code as a fundamental push to protect freedom of speech from government and corporate control. As anthropologist Chris Kelty (2008, p. 8) argues, "Coding, hacking, patching, sharing, compiling, and modifying of software are forms of political action that now routinely accompany familiar political forms of expression like free speech, assembly, petition, and a free press. Such activities are expressive in ways that conventional political theory and social science do not recognize: they can both express and 'implement' ideas about the social and moral order of society." The FSF argues, therefore, that FOSS movements encompass a much broader range of social and political issues such as information access and control.

GNU and Linux

Stallman's goal, through the FSF, was to develop an entirely free computer operating system which could be downloaded, utilized, and changed by anyone. Stallman's training was in the Unix operating system, one of the most widely used operating systems for large mainframe computers at universities and government laboratories at the time. The problem, however, was that Unix was a proprietary operating system (owned at the time by AT&T) and could not be distributed to other users without the threat of copyright infringement. Stallman and a group of programmers therefore took it upon themselves to begin re-writing the Unix operating system from scratch, one application at a time. Between the 1985-1992 period, they succeeded in replacing almost every Unix application that programmers relied upon. Stallman playfully referred to this new collection of programs as GNU, which stood for "GNU's Not Unix" - a recursive acronym. Despite the usefulness and popularity of some of these re-configured programs among computer hackers and enthusiasts, they remained a loose collection of applications that did not cohere together as a full operating system. It was a young Finnish computer science student named Linus Torvalds who in 1991 actually finished the GNU operating system by creating the kernel for a version of Unix called Minix (Weber, 2004, pp. 54-55) Armed with his new operating system, which he dubbed “Linux,” along with Stallman’s GNU tools, he began to distribute an entirely free operating system which would develop throughout the 1990’s and 2000’s into a viable alternative to Windows and other proprietary operating systems.

Legal Foundations for Open Source: The GPL & Free Speech

Many FOSS projects, including GNU/Linux, have progressed beyond simple “adhocrasies” and bazaar-style organizations to create sophisticated institutional structures of their own. These infrastructures have not only regularized the development of open source software, but have also provided an organizing structure for nascent FOSS social and political movements. A critical aspect of new organizational self-awareness is the self-definition of Linux hackers, FOSS developers, and open source software users as free speech advocates in opposition to the closed, proprietary software that is in widespread use on personal computers today. The legal cornerstone of free speech in open source software communities is the GPL, or GNU General Public License. Stallman’s vision for new technologies free from the confines of proprietary software would have been only an idealistic fantasy if it attempted to survive under existing copyright regimes. Consequently, Stallman initiated a substitute system for copyrighting software. Rather than protect the property rights of the individual creator, Stallman’s version turns the notion of copyright (which links specific lines of computer code with individual property) on its head by keeping software in the public domain in perpetuity, something that he playfully refers to as “copyleft”. In essence, the GPL ensured that the four essential software freedoms would remain intact whenever free software was modified and redistributed by other users. If the end user decides to change GPL-protected software and distribute that new software code to others, then another provision of the open source definition comes into play: that individual must be distributed under the same terms as the original software, that is, with the source code revealed and the opportunity for those new users to modify and redistribute the software (Open Source Initiative, 2009). It also prevented users from adding proprietary software to GPL’d software and then obtaining a restrictive license for the newly-created program, making it impossible to “combine a free program with a non free program *unless* the entire combination is then released as free software under the GPL” (Free Software Foundation, 2009b; Weber, 2004). The GPL was a major innovation in Stallman’s battle with multinational corporations like AT&T (which owned the rights to the Unix operating system) since it turned “copyright law against itself, limiting its reach and carving out a legally protected zone to build and protect the public domain” (Bollier, 2008, p. 30)

The GPL and the attempt to redirect the restrictive practices of copyright law as it pertained to computer software was the first step in expanding the boundaries of free speech beyond the specific interests of computer hackers to encompass much broader concerns about the restriction of culture in a networked society. By creating a legal alternative to copyright, Stallman “provided the rudiments of a rival liberal legal vocabulary of freedom, which hackers would eventually appropriate and transform to include a more specific language of free speech” (Coleman, 2009, p. 424). Increasingly, open source communities are also becoming more sophisticated in their facility with the legalities of copyright law, becoming ersatz copyright lawyers in their use of various software licensing schemes in order to challenge the existing intellectual property regimes. As Coleman (2009, p. 421) explains in her overview of legal and political activism among FOSS developers, "developers construct new legal meanings by challenging the idea of software as property and by crafting new free speech theories to defend this idea of software as speech." In particular, Coleman describes how new developers for Debian, a version of the Linux operating system and the largest open source software project in the world, must complete an extensive application which asks them detailed questions about different sorts of software licenses under the GPL, including how to "correct" some existing software licenses to being them into compliance with the Debian Free Software Guidelines (DFSG) or the GPL. These practices not only maintain the integrity of the Debian operating system, but they also help to form a coherent social movement by "transforming technologists into informal legal scholars who are experts in the legal technicalities of FOSS as well as proficient in the current workings of intellectual property law" (Coleman, 2009, p. 422)

Along with these activities among hacker communities, a number of key non-profit organizations have taken shape in the last 15 years which have bolstered the legal power of open source software licenses, including the GPL. Richard Stallman's decision to resign from the artificial intelligence laboratory at M.I.T. and to start the Free Software Foundation (FSF), for instance, gave a public face to the movement and allowed him to begin soliciting donations to support the development of free software tools. The FSF has continued to support the cause of free software both by channeling donations and by bringing attention to some of the perils of proprietary software. Their "Bad Vista" campaign from 2006-2009, for example, helped to focus media attention on the fact that Microsoft no longer sold their operating system to end users – instead, the software was only "licensed" to these users, which gave Microsoft the ability to potentially remotely disable a user's computer through the use of a so-called "kill switch" (Free Software Foundation, 2006). More recently, the Software Freedom Law Center (SFLC), a non-profit organization founded in 2005 to support FOSS developers with legal advice on software licensing and offers "license defense and litigation support," is in some ways analogous to the American Civil Liberties Union (ACLU) in that it serves as a watchdog for GPL-licensed software and will file injunctions and engage in other court actions to prevent the 'contamination' of open source software with proprietary code (Software Freedom Law Center, 2009a). In December 2009, the SFLC filed suit against major consumer electronic companies and retailers such as Samsung, Westinghouse, JVC, and BestBuy for releasing proprietary products which utilized GPL-protected software called BusyBox (Software Freedom Law Center, 2009b). This action is only the most recent in a string of incidents in which proprietary software developers (one of them was Microsoft) have been informed by the SFLC that they have violated the terms of the GPL. The existence of visible organizations such as the SFLC and the FSF, then, has given the FOSS movement a centralized public identity and have protected the existence of the digital commons from incursions by profit-driven electronics and software companies. These organizations also serve to shape and define the very *definition* of free, open source and act as sources of contact for the media, all of which are critical institutions that fashion a notion of self-identity for the FOSS movement.

Creative Commons and the Notion of Socially Created Value

The efforts of software hackers and open source advocates to emphasize the collective, communitarian ethos of the Internet has also inspired activists to expand the notion of the public domain to include all information and creative works. The rallying cry of free software advocates for openness in both the code and the content of new media on the Internet has also dovetailed with the broader free culture movement, which has worked to circumvent the restrictions of copyright law in order to reserve the rights of individuals to use, modify, and redistribute cultural materials. The aims of the free culture movement read like a social justice manifesto as well. As Lawrence Lessig (2004, p. 261), one of the key figures in the free culture movement, writes: “So uncritically do we accept the idea of property in culture that we don’t even question when the control of that property removes our ability, as a people, to develop our culture democratically.” Modeled on Stallman’s GPL, Lessig and two colleagues created an alternative copyright regime for cultural materials in 2002, the Creative Commons (Creative Commons, 2009). In essence, Creative Commons was conceived as a private “hack” to produce a more fine-tuned copyright structure, to replace “all rights reserved” with “some rights reserved” for those who wished to do so. It tried to do for culture what the General Public License had done for software” (Boyle, 2008, p. 182)

The ultimate goal of alternative copyright systems such as Creative Commons and the GPL is to preserve the ability of individuals to both share and build upon each other’s knowledge, artistic creativity, and expertise. This not only reduces barriers for individuals to participate with one another in communal projects, but it also works to equalize access to information for all members of society, which is a core aim of classic redistribution theories of social justice. New forms of value and innovation are created through this new form of networked creativity, which have been collectively dubbed “the commons.” The commons is

> a vehicle by which new sorts of self-organized publics can gather together and exercise new types of citizenship. The commons can even serve as a viable alternative to markets that have grown stodgy, manipulative, and coercive. A commons arises whenever a given community decides that it wishes to manage a resource in a collective manner, with special regard for equitable access, use, and sustainability. The commons is a means by which individuals can band together with like-minded souls and express a sovereignty of their own (2008, p. 4)

New means of modular, collective cultural production thrive on a vibrant public domain. Since this is increasingly under threat, FOSS projects which release their software under the GPL are advancing a critical 21st Century goal toward collectivism which is at the forefront of the social justice purpose. One simply has to look at the motivations behind most forms of cultural production to realize the historical shift in perspective. Under the traditional systems of copyright, the end goal of artistic and intellectual creation is to generate private property which, while it may be experienced by others, ultimately serves to benefit the creator. Under “copyleft” regimes like Creative Commons and the GPL, the goal of cultural production is to add value and creativity to a set of resources to which everyone has free access. This not only encourages more creativity which can then be fed back into the collective commons, but it creates new incentives for intellectual production that go beyond the accumulation of capital.

As a result of the possibilities for innovation offered by the collective commons, new forms of cultural production are also being created, many of which challenge the existing wage-labor system of post-industrial capitalism. Like software engineers in general, along with teachers, artists, and others who work in the cultural industries, open source hackers are knowledge workers. What is less obvious about hackers is the fact that their efforts lie outside the traditional realm of the capitalist economy, since the goal of the software is to be freely available to computer users around the world. Absent the profit incentive, there are a number of other motivations that typify hacker involvement in FOSS. Instead of a work environment structured by institutional or market-based demands, free software communities are often loosely organized and centered around the contributions of lines of code in order to solve specific problems. Since the computer code written by hackers is an abundant resource, writes hacker anthropologist and spokesperson Eric Raymond (2001), the social and economic model of open source communities most closely resembles a *gift culture*. Raymond writes that

> abundance makes command relationships difficult to sustain and exchange relationships an almost pointless game. In gift cultures, social status is determined not by what you control but by *what you give away (2001, p. 81)*

Giving or uploading useful code to the community not only provides others with a gift, but it also establishes one's reputation as a successful hacker through positive recognition from the community of other hackers. For Castells (2002), this suggests a "techno-meritocratic" culture which develops among online hacker communities. He writes:

> Naturally, money, formal proprietary rights, or institutional power are excluded as sources of authority and reputation. Authority based upon technological excellence, or on an early contribution to the code, is respected only if it is not seen as predominantly self-serving. In other words, the community accepts the hierarchy of excellence and seniority only as long as this authority is exercised for the well-being of the community as a whole, which means that, often, new tribes emerge and face each other. But the fundamental cleavages are not personal or ideological: they are technological (2002, p. 48)

In this utopian vein, Castells and other scholars of the post-industrial transition suggest that technological prowess creates new possibilities for autonomy, individuation, and freedom from wage capitalism which emerges from the networked interfaces of the post-industrial economy (Bell, 1973; Hardt & Negri, 2001). FOSS movements fit somewhat naturally into this vision because the tools to rewrite the basic operating code of networked computers are readily available on the web for anyone with access and patience to master. The power to change the technological course of society, therefore, is effectively taken out of the hands of industrial elites and reclaimed by individual hackers who choose to work on open source projects to fulfill their own goals and desires. This devolution and re-distribution of creative power from powerful software corporations to the people is one of the primary social justice appeals of the greater FOSS movement.

For instance, FOSS advocates often point to the Mozilla Firefox web browser as the project which most clearly demonstrates the power and value of collective labor in a networked information economy. The Netscape browser, released in 1995 and based upon Mosaic, the first graphical browser for the Internet, was a favorite with end users (because it gave away its product for free) and was a much faster Internet interface than Microsoft's Internet Explorer (IE). To counter this growing threat during the boom times of the late 1990's, Microsoft began bundling IE into new version of its operating system, making the browser the default one upon installation and integrating its functions into Windows. Although Microsoft was eventually sued by the Justice Department for these actions, the Netscape Corporation began to falter in the late 1990's until it made a fateful decision for the future of the free software world in January of 1998: it decided to release the source code for the browser and set up a non-profit organization (called the Mozilla Foundation) to look after the development of the browser.[2] To make the notion of free software more palatable to business interests, a number of hacker advocates led by Eric Raymond adopted the term "open source" to avoid the misleading term "free" (as in no cost). Along with convincing Netscape to reveal the source code for its browser, Raymond urged his compatriots to standardize their terminology around the open source moniker, as well as to co-opt the business media such as the *Wall Street Journal*, *The Economist*, and *Forbes Magazine*, which predominantly reflected the interests of the Fortune 500 (Raymond, 2001, pp. 178-179) The new Mozilla browser, nicknamed Firefox, thereafter began a new phase in its development; one which took place in the open, and which allowed hackers and end users to understand how the software worked in order to write additional "add-ons" to extend the functionality of the browser, all under the terms of a license which kept the browser in the public domain. Today, Mozilla Firefox is one of the most popular applications for browsing the web and has demonstrated the staying power of an open source project in an environment that has hitherto privileged proprietary, closed systems. Although the advocacy community began to debate the relative merits of "free software" versus Raymond's "open source" terminology, the catalyzing event of Netscape's re-birth as an open source project crystallized Stallman's early vision into a larger social movement by giving it a recognizable rhetorical frame and by the creation of a new non-profit entity to spearhed its public image, the Open Source Initiative (OSI). As Kelty notes, "the practice of creating a movement is the practice of talking about a movement...It was in 1998-99 that geeks came to recognize that they were all doing the same thing and, almost immediately, to argue about why" (2008, p. 98)

Conclusion

The development of the GNU/Linux operating system and other open source software projects in the 1990's point to some important trends in the networked economy of the 21st Century. First, FOSS projects like GNU/Linux and Firefox are mounting serious technological and economic challenges to proprietary software such as Microsoft Windows and Internet Explorer. As a byproduct of their collective efforts, open source computer programmers and users are increasingly connecting their own activities to larger philosophical issues of free speech and greater access to information. Indeed, FOSS

2 The Netscape Corporation was purchased by America OnLine (AOL) in November of 1998, but not before they had released the source code to their browser under the newly-created Mozilla Public License (which had a structure very similar to the GNU Public License).

movements have catalyzed interest in issues of excessive copyright protections enjoyed by corporations which has expanded the reach of these movement beyond computer programmers and technology geeks. The development of FOSS has made significant inroads in the last twenty years because of the creation of some core institutions (such as the FSF and SFLC) which serve to further the interests of free software, and because of new “copyleft” regimes such as the GPL and the Creative Commons. Finally, the free software movement has also spearheaded the development of alternative form of cultural labor, one which harnesses the power of collective labor via the Internet which exists parallel to, and often in opposition to, the wage labor system of post-industrial capitalism. Although the goals of these movements have yet to be fully realized, the coordinated efforts of these loosely organized volunteers and hackers have already begun to change the ways that we think about information and computers in a networked society.

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Promoting Openness by “Patching” European Directives: Internet-based Activism & EU Telecommunication Reform

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Abstract

This paper analyzes how activists, rooted in the free/libre and open source software movement (FLOSS), interfere in European Union decision-making in order to advocate principles of freedom, openness, transparency, access to information, participation, creativity, and sharing. We base our analysis upon a case study of a French activist group’s campaign against the introduction of repressive copyright measures and for Net neutrality in the reform of the Telecoms Package, a set of five directives regulating the European Union’s telecommunications sector. We discuss how free and open source principles sustain their action repertoire and claims during this campaign in the light of recent literature regarding internet activism and the FLOSS movement.

Keywords: Internet activism, Open source, European Union, telecommunication, intellectual property rights

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> "Netcitizens now dispose of research possibilities that used to only be accessible to State news services. The internet opens channels for participation, creates more transparency and changes the communicative relations between actors and institutions. (...) *Internet innovation acts as some kind of social revolutionary force of our time*. That's why electronic media are also the object of conflicts of interests, as their regulation decides on the structural change for the future." (Rebentisch 2005, p. 1, italics in original)

Introduction[1]

Information and communication technologies (ICTs) have come to play a significant role in our daily lives and activities. Along with their integration in society comes the dissemination of know-how's, habits and ways of thinking that used to be limited to the domain of ICT experts and technicians (Riemens, 2002). Protest groups in particular are increasingly relying upon ICTs in order to make their voices heard. Most notably the internet has become a major vehicle for political activists of all beliefs. The Net has become an important place for activism as well as a "common good" to fight for in itself.

The conflict between emergent protest actors and established power holders is particularly striking in the domain of intellectual property rights. In the past decade, elected bodies in the Western world have come under increasing pressure to adopt more restrictive legislation in the domains of copyright (e.g. to prevent unauthorized file-sharing) and other forms of intellectual property rights (e.g. software patents). "Today, copyright law is no longer a complicated issue that is only of interest and concern to copyright lawyers, legal scholars, technology developers, and copyright holders," argues the US law professor Peter Yu. "Rather, it is a matter of public significance, affecting all of us in our daily lives" (2003, p. 909). Internet-based protest groups have contributed a great deal to increasing public awareness of copyright issues. Furthermore, they are emblematic of how communities of interest are emerging on the internet, and of how some of these become politicized and influence traditional decision-making.

The paper analyzes the case of la Quadrature du Net, a French citizen collective established in March 2008 in response to a legislative proposal aiming at introducing the "three-strikes-and-you're-out-scheme" in France. "Three-strikes" or "graduated response" refers to the implementation of a mechanism automatically detecting unauthorized file-sharing, leading in its most extreme form to cutting off copyright infringers' internet connection after two unsuccessful warnings. "Three-strikes" is only the latest in a series of battles generally referred to as the "copyright wars" in which the entertainment industry uses any possible venue in order to counter copyright infringements, including lobbying, litigation, education and licensing (Yu, 2003). The intellectual property rights (IPR) lobby has successfully established the term 'piracy' as a synonym for copyright infringement. 'Piracy' is claimed to

[1] Replication statement: This paper is based upon twenty in-depth interviews that have been transcribed and coded. All transcripts as well as the project's codebook will be deposited in a public archive as soon as the research project is completed (scheduled for October 2011). Confidential information received from interviewees will be removed from the transcripts prior to making them public. All interviews are anonymized and references that might lead to the identification of participants will be removed.

be responsible for a sudden drop in IPR-based revenues over the last two decades. In 2007, the Business Software Alliance published a ‘Piracy Study’ reporting a loss of US$29 billion due to pirated software (BSA, 2007). “Three-strikes” is intended to become an additional weapon in the arsenal of IPR litigation, next to suing individuals and copyright-infringing platforms (such as Napster, and more recently, The Pirate Bay) and pushing for national parliaments to adopt supranational legislation such as the World Intellectual Property Organization (WIPO) treaties and the Anti-Counterfeiting Trade Agreement (ACTA) currently under negotiation.

Collective action prompted by repressive intellectual property regulations is particular in that it mobilizes a constituency of self-baptized “netcitizens” whose repertoire of action and underlying philosophy draw upon open source culture. The paper examines the case of a French citizen collective, la Quadrature du Net, who successfully intervened in the reform of the Telecoms Package, a set of five directives regulating the telecommunications market in the European Union. The question we wish to address is in which ways principles of freedom, openness, transparency, access to information, participation, creativity and sharing inform this type of internet-based activism and are brought into conventional forms of decision-making.

The case study is part of a broader research project that analyzes internet-based campaigns aiming to influence EU decision-making in the domains of intellectual property rights, internet regulation and digital rights. It draws on a series of twenty interviews conducted with two set of actors: core activists from la Quadrature on the one side, staff and members of the European Parliament, the main targets of the campaign, on the other side.

The outline of the next sections is as follows: section 1 examines the particular place of collective action surrounding copyright legislation in the light of the current literature on internet activism and e-mobilization, section 2 presents the free/libre and open source movement and the principles promoted by it, section 3 briefly explains how the data sustaining this analyzes has been collected, section 4 analyzes la Quadrature du Net’s Telecoms Package campaign, focusing on the ideology of openness and freedom that sustains their actions, the campaign in itself and an analysis of the particular action repertoires they made use of during the campaign. Finally, the findings are discussed in the light of the literature (section 5).

Internet-based Activism

Action groups of all types have colonized the internet in order to express their views and publicize their political claims. “Cyberspace has become a global electronic agora where the diversity of human disaffection explodes in a cacophony of accents,” asserts Castells (2001, p. 138). Vegh defines internet activism as “a politically motivated movement relying on the internet” (2003, p. 71). This ranges from minorities struggling against oppression, such as the Zapatistas (Arquilla and Ronfeld, 2001; Garrido and Halavais, 2003) and more recently the Uiygher, to social movements like the global justice movement (Van Aelst and Walgrave, 2002; Juris, 2005; Mattoni, 2008; Kavada, 2005, 2008), specific anti-corporate or anti-globalisation movements (Juris, 2005; Kavada, 2005, 2007; Niesyto, 2007; Baringhorst, 2008), the feminist movement (Edwards, 2004; Pini, Brown and Previte, 2004), alternative media movements such as Indymedia (Kidd, 2003) and digital rights campaigns (Denning, 2001; Jordan and Taylor, 2004; Jordan, 2008), human rights movements (Lebert, 2003), or the anti-war movements (Shaw, 2005; Gillan, 2008). Any minority or oppositional group one can conceive of is likely to be present on the internet.

A substantive part of the literature concurs that the internet transforms collective action. For Postmes and Brunsting (2002) the motives underlying collective action are transformed by the adoption of internet use and may in turn alter the nature of collective action and protest groups. Next to traditional forms of collective action that existed prior to the advent of the internet, new online forms unfold, turning the internet in a "new tactical site" (Lee, 2009, p. 16). An additional layer of internet-based actions complements the repertoire of collective action, meaning a set of tactics and strategies consciously chosen by protest actors based on their experience in order to act collectively (Tilly, 1984).

Following Van Laer and Van Aelst, "on the one hand, [the] internet facilitates and supports (traditional) offline collective action in terms of organization, mobilization, and transnationalization and, on the other hand, creates new modes of collective action" (2009, p. 3). Internet-supported actions, to employ the terminology put forward by Van Laer and Van Aelst, are complemented by "virtual" activities, or internet-based actions, such as email bombings, sit-ins in online spaces or hacking Web sites. Vegh (2003) distinguishes between internet-enhanced strategies, i.e. the internet serves as an additional channel for protest, and internet-based tactics, i.e. the internet constitutes a space for actions that are only possible online.

As the example of la Quadrature du Net's campaign will show, 'online' and 'offline' spheres are not separate realities. Protest groups generally draw on a variety of tactics both offline and online (Van Laer and Van Aelst, 2009). The 'online' should be viewed as an extra layer of protest actions that sometimes replaces (e.g. emails frequently substitute letters) and mostly complement conventional forms. 'Online' and 'offline' realms are heavily interdependent (Bimber, 2000) and their opposition is increasingly rejected as a false dichotomy (Kneip and Niesyto, 2007). In the paper, the 'online' should not be understood as separate from the 'offline' but as spheres that are primarily technology-mediated or not.

Much attention has been paid to the way traditional political actors such as political parties, interest groups and social movements are integrating ICTs in their political strategies. However, the appropriation of internet-based repertoires by a wide range of political actors blurs the traditional distinction between political actors. Chadwick argues that established political actors, such as interest groups, political parties and social movements, undergo a process of hybridization, meaning the "selective transplantation and adaptation of digital network repertoires previously considered typical of social movements" (2007, p. 283). Simultaneously, internet-based actors – MoveOn in the US is the most frequently cited example - emerge as a new kind of organizational form. These "hybrid mobilization movements" mix protest repertoires that used to be associated with established political actors. They also take advantage of the complex spatial and temporal interactions engendered by digital communication networks (Chadwick, 2007).

Internet-based activism should not automatically be reduced to social movements types of action. Internet-based activists share common characteristics with social movements: they aim for social change, adopt identity-based network structures and the use of 'unconventional' means of protest to challenge established elites (Rucht, 1994). However, social movements represent a certain "institutionalization of [a] particular struggles" (Cammaerts, 2007, p. 217) while ICTs clearly reduce the incentive to join established organizations (Earl and Schussman, 2003). A recurring characteristic of internet activism is the great variation in organizational structures relying on ICTs to promote social and political change (Bimber et al., 2005). It is therefore more accurate to speak of internet-based or -supported collective action, which encloses both formalized and informal, established and emergent types of protest structures. It is beyond the scope of the paper to argue whether internet-based activism constitutes an emergent social movement. In order to avoid confusion with the various – and sometimes contradicting - definitions of social movements, we refer to the actors examined below as protest groups or activist networks, focusing the attention on their claims and repertoire rather than organizational forms.

The Internet as a Resource for Activism

Internet-based protest groups are perceived as emblematic of a general transformation - or adaptation - of collective action and more generally political participation in post-modern societies. Traditional political institutions such as the nation state and the representative system are contested in an era of economic globalisation characterized by dense networks of communication. The advent of the internet in the 1990s fostered hopes for an invigorated public reconnected to decision-makers thanks to networked communication technology. Such expectations have equally emerged with the invention of previous technologies like the telegraph, the radio or the television (Vanobberghen, 2007, Hoff and Bjerke, 2009). Whether internet use by protest groups actually leads to increased participation, reinvigorates tired democracies or leads to important power shifts within society is an ongoing debate in the academic literature. For Van Laer and Van Aelst:

> "Political and economical power has gradually moved to the international level. The Internet enabled social movements to follow that transition and operate more globally. One could state that the Internet made it possible to maintain the status quo, but not change it." (2009, p. 29).

Next to using the internet to act at a transnational level, internet-based activist groups are generally keen on the decentralized structure of the internet that mirrors their ideological and organizational needs (Castells, 2001; Bennett 2004; Van Laer & Van Aelst, 2009). Internet-based collective action facilitates individualized forms of protest, embodied by a loose network of actors who share a common goal and set of values. Non-professional individuals motivated by personal interests and relying on their own skills for undertaking movement activity, "Movement entrepreneurs" (Garrett, 2006), emerge as new agents of mobilization. This development is in line with a general process of individualization that is shaping political practices (Dahlgren, 2009). Citizens tend to make political connections by following personal interests and life-style choices rather than overarching traditional ideologies (Cammaerts and Van Audenhove, 2005). Issues closer to everyday life, identity-politics or single-issues such as in the case examined here, intellectual property rights, constitute important triggers for citizen involvement.

Thanks to the internet, activists do not need to be in the same geographical location to follow, join or oppose other groups or issues (Baringhorst, 2009; Van Laer & Van Aelst, 2009). Movement entrepreneurs active on different levels or countries do not necessarily know each other personally but observe each other on the internet, developing common understandings of a shared political issue (Baringhorst 2009). As such they may act locally but are tied to a larger network of activists operating in various countries and on several levels. They conflate the local and global, leading to what Wellman et al. (2003) have coined as ‘glocalisation’; they bridge scales by ‘thinking globally and acting locally’.

One of the most salient characteristics of internet-based protest groups is that communication becomes the foremost political strategy, making "campaigns, themselves, political organizations that sustain activist networks in the absence of leadership by central organizations" (Bennett 2004, p. 130). Activists groups exploit the various communicative functions of web spaces in different ways. Stein (2009) has proposed a typology of these functions that ranges from information provision and fundraising, to enabling dialogue and interaction leading to mobilization and facilitating linkages between various groups (see section 4).

Internet-based protest groups adopt “viral politics”, i.e. the rapid sharing of information to personal acquaintances across the internet resulting in political mobilization (Gustafsson, 2009; Breindl & Gustafsson, 2010). Such a practice is not new in itself. “The reason that viral politics can be seen as a partly new and potentially transforming factor in political life is the increased velocity and scope of the communication,” argues Gustafsson (2009, p. 10).

The growth of social media has further amplified this phenomenon. Social media or Web 2.0 applications facilitate more flexible and individualistic protest activities based on user-generated content. They offer new possibilities, such as the propagation of content over multiple applications, rich user experiences on political websites or the creation of small-scale forms of political engagement through consumerism (Chadwick, 2009). The boundaries between producers and consumers of information blur leading to “produsage” (Bruns, 2008) or the collaborative creation of content. Individuals themselves generate and control creation processes such as posting, classifying or evaluating content online.

The internet lowers the barrier of entry into political debates and activism. Each participant can choose himself how much time, resources and effort he is willing to invest in a particular campaign. “Flexible participation” (Joyce, 2007) embraces a wide variety of individualized protest activities, such as joining a Facebook cause, signing a standard letter of support or contributing actively to the campaign wiki. Internet-based groups. Removing the need for large mobilizing structures, the internet allows to efficiently aggregate small contributions and lowers the barriers for participation for interested actors.

The internet and ICTs in general are valuable resources for protest actors. They help build their identity, support their organizational forms and action repertoires. However, technologies themselves are the terrain of political controversies. For some, “they are viewed as instruments of the dominant power and as responsible for the perverse effects of globalization," write Bucchi and Neresini (2008, p. 454). At the same time, computer technologies are endowed with democratic imaginations, and expected to liberate individuals from oppression and domination. The relation between technology and protest actors is thus far from unequivocal, most particularly in the domain of technonology-oriented activism that interests us.

The Internet: A Contested Terrain

The internet is a "social structure created through repeated collective social action" (Rasmussen, 2007, p. 45). It has been shaped by particular social, political and cultural conditions and continues to be shaped by social action. The history of the internet has been one of continuous tensions between various groups interested in its development. Prompted by the defense sectors' enormous budgets, the early history of the internet took place in non-commercial spaces in which the creators were also the users. The scientific community applied meritocratic values and engineering principles to the construction of a global communication network intended for the well being of all humans. At its conception, the internet's architecture was intended to be and perceived as essentially open and thus neutral and non-political (Rasmussen, 2007).

For O'Reilly (2004), the architecture of the internet is inherently participatory: "any system designed around communications protocols is intrinsically designed for participation. Anyone can create a participating, first-class component. (…) The web, however, took the idea of participation to a new level, because it opened that participation not just to software developers but to all users of the system," (O'Reilly, 2004). This 'architecture of participation' (Lessig, 1999) was inherent to the internet way before the advent of Web 2.0 or social media platforms. It designates a system that is "designed for user contribution" (O'Reilly, 2004). More generally, the hyperlinked architecture of the internet "ensures that the value of the web is created by its users" (Ibid.).

With the rapid spread of the internet in the 1990s, its architectural openness has come under increasing pressure as formal organizations are systematically seeking to reassert their power in the digital realm. As Lessig argues, an "extraordinary amount of control can be built in the environment that people know as cyberspace" (1999, p. 217). The tension between openness and closeness has repeatedly played out "in the construction of the ARPANET, in the struggle for an open Internet protocol, in the fight to promote open source code and to prevent restrictive forms of copyright and patenting, in the anti-trust cases against Microsoft, and in the battle against censorship," argues Rasmussen (2007, p. 2).

A particular type of community has taken advantage of the internet's open architecture at the very early stages of its development: hackers. When thinking about hackers, the media cliché of a computer criminal often comes to mind. However, "true hackers" are computer aficionados who share a common ethic, which promotes open access to computers, decentralization, informational freedom, the mistrust of authority, recognizes judgments based upon hacking skills alone, encourages the possibility to create art and beauty on computers, and believes in the fact that computers can change life for the better (Levy, 1984,

p. 27-33). “It is a culture of technological creativity based on freedom, cooperation, reciprocity, and informality,” argues Castells (2001, p. 50). The free/libre and open source software (FLOSS) movement finds its roots in this “hacker culture” (Thomas, 2002), and is arguably one of its most politically oriented extensions.

The FLOSS Movement

Open source software introduces a paradigm shift in software development (O’Reilly, 2004; McInerney, 2009). For Weber:

> “collaborative open source software projects such as Linux or Apache have demonstrated that a large and complex system of software code can be built, maintained, developed, and extended in a nonproprietary setting in which many developers work in a highly parallel, relatively unstructured way” (2004, p. 2)

The participatory development model of open source is generally opposed to traditional, top-down software designs. Open Source advocate Eric S. Raymond (1999) distinguishes the former as the bazaar model, in which the source code is publicly available and where each developer chooses what to work on. The latter has been named the Cathedral model in which the source code is restricted in the hands of a small group of developers in a hierarchical manner. Open source generally adopts the bazaar model whereas proprietary software such as those distributed by Microsoft or Apple tends to follow the Cathedral development.

Two different approaches to property collide: the conventional notion of property as a right to exclude versus the right to distribute what one owns, advanced by open source projects (Weber, 2004). Free software advocates postulate that software constitutes a public good (Williams, 2002 in Rasmussen, 2007), and pursues an inherently political aim: free software as a vehicle to spread the principles of informational freedom and a non-proprietary vision of society. As such, free software developers are often considered to be political activists. The open source community, emerging as a second stream in the larger FLOSS movement from 1998 onwards, expresses a more technological ideology: the open accessibility of code enables the development of better software. Political concerns are secondary or absent to the technological progress enabled by open source software.

FLOSS cannot be said to be one homogenous movement. It is foremost a model for software development. Open source is full of nuances as exemplified by the two major streams, free software, on the one side, and open source, on the other side. Both “offer poles of attraction for the developers” (Berry, 2008, p. 142). Yet, only a minority of programmers sees fundamental differences between open source and free software. For most, developing software is a similar task in both communities (Infonomics, 2002 quoted in Berry, 2008, p. 142).

Politically engaged programmers and non-programmers are often implicitly drawing upon open source principles when intervening in political decision-making. One of the characteristics of FLOSS is the transpolitical appeal of its messages, attracting supporters from across the political spectrum. For Berry:

> "the key site of contestation and the source of unity for FLOSS developers has been their rejection of the use of IPRs to protect or monopolize certain aspects of the common use of coding conventions, routines or algorithms" (Berry, 2008, p. 103).

Changes to copyright law have triggered widespread opposition among FLOSS supporters. When the Digital Millennium Copyright Act (DMCA) in the United States (1998) or the European Copyright directive (2001) criminalized the production and distribution of technology bypassing copyright protection, both proposals encountered strong opposition amongst FLOSS advocates.

At present, the FLOSS and hacker discourses have spread from programmers to non-programmers who sympathize with their core ethics (Rasmussen, 2007). Various activist movements found inspiration in values of sharing and openness and applied these to other political domains such as human rights, environmentalism and social justice. Lessig's Creative Commons licenses or Wikipedia's GNU Free Documentation License are extensions of the alternative distributive copyright rules developed for free software with Stallman's General Public License (Jordan, 2008) or the Berkeley Software Distribution (BSD) license. A much broader 'digital rights movement' is taking shape across the globe. It draws and extends upon the original hacker ethic as laid out by Levy (1984), merges with other civil society movements (e.g. human rights) and proposes an original mix of open source, enlightenment and libertarian frames. The French internet-based collective, La Quadrature du Net, and it's campaign surrounding the Telecoms Package reform, constitutes an appropriate case study for examining the principles behind their discourses and action repertoires and to what extent these are affiliated with open source culture.

Methods

The analysis of the Telecoms Package campaign is part of a broader research project (cf. Breindl & Briatte, 2009; Breindl, 2009, Breindl & Gustafsson, 2010, Houghton & Breindl, forthcoming). It has been selected because it constitutes the most recent example of an internet-based network of activists campaigning to influence EU decision-making on these issues. Collective action surrounding intellectual property tights (IPR) is a fertile ground for internet activism. The tools and objectives pursued coincide. La Quadrature du Net is an emblematic example of networked, transnational, internet-based activism in a domain that has been tremendously transformed by ICTs.

The paper draws upon a series of twenty interviews with core actors of the Telecoms Package reform: on the one side central campaigners and supporters of la Quadrature du Net, on the other side parliamentary assistants, political advisors and members of the European Parliament (MEPs), the main targets of the campaign. The selection of interviewees followed a 'snowball sampling' strategy: initial contact was made with a leading campaigner, who was then asked to suggest further persons to interview. Each interview lasted for about one hour and a half. The interview guide consisted of open-ended questions as to the campaigning techniques, internet use, the community they stem from, the values they support, la Quadrature du Net in particular, the challenge to influence EU decision-making, the different stages in the campaign, their vision of internet-related policy issues, and collaboration with third parties. Additionally, EP targets were interviewed on how they perceived the activities of la Quadrature, which will be developed in more detail in a future article.

The in-depth interviews were triangulated with an analysis of la Quadrature's main campaign site[2] and wiki[3] as well as data consisting of campaign documents generated by the activists themselves such as press releases, messages posted on mailing lists and online social networks. Additionally, documents and analyzes provided by political staff inside the EP were also taken into account. All interviews and data collection were carried out between February 2008 and January 2010. The data has been analyzed from a thematic, inductive perspective.

La Quadrature du Net: Promoting Openness by "Patching" EU Law

La Quadrature du Net (la Quadrature in short) is a French citizen-collective, without statutes or an elected board, established in March 2008 in response to president Nicolas Sarkozy's announcement to introduce a three-strikes plan, negotiated with the record industry and internet providers. The name Quadrature du Net (Squaring the Net in English) originates from the mathematical problem of squaring the circle, i.e. the impossibility to construct a square that holds the same area as a circle in a certain number of steps with compass and straightedge. In 1882, the German mathematicians Lindemann and Weierstrass established that π is transcendental, proving impossible to solve the problem of squaring the circle. By analogy, Squaring the Net refers to the inadequacy of transposing traditional legislations directly upon the digital environment. On their internet site la Quadrature states "we believe that it is impossible to effectively control the flow of information in the digital age by the law and the technology without harming public freedoms, and damaging economic and social development. This is what we call Squaring the Net"[4]. The group aims at preventing legislations that might harm their conception of a free and open internet and promotes the respect of fundamental rights and the inherently democratic character of the internet. Just like Lindemann and Weierstrass enriched mathematical thinking by establishing the transcendence of numbers, la Quadrature considers that regulating the internet poses new challenges, which can only be solved by progressive legislation and out-of-the-box thinking.

La Quadrature du Net is a hybrid protest group (Chadwick 2006) mixing protest actions characteristic of social movements - such as demonstrations or alternative media coverage of a certain issue – and actions traditionally associated with interest groups – such as legislative analysis, lobbying, participating in conferences or organizing events. These actions take place both in the online and offline realm, are internet-supported (e.g. fundraising) and internet-based (e.g. protest websites).

La Quadrature defines its activities as advocacy "for the adaptation of French and European legislations to respect the founding principles of the Internet, most notably the free circulation of knowledge" intervening in "public-policy debates concerning, for instance,

[2] http://www.laquadrature.net/ (last accessed 23/10/2010)
[3] http://www.laquadrature.net/wiki/Main_Page (last accessed 23/10/2010)
[4] http://www.laquadrature.net/en/faq-0 (last accessed 10/01/2010)

freedom of speech, copyright, regulation of telecommunications and online privacy”[5]. More generally, their actions encourage citizen participation and debate on “rights and freedoms in the digital age”[6].

The core of la Quadrature du Net is constituted by five founders, four men and one woman, all of whom are sensitive to the free/libre and open source software movement. Thanks to an annual funding by the Open Society Institute[7], one core campaigner and a half-time assistant receive a salary for their work. For the rest, la Quadrature operates on a voluntary basis, with contributors following and participating in the discussion list and on the Internet Relay Chats (IRC). A small group of core activists regularly analyzes legislative texts, works on press releases, edits the campaign wiki, translates documents, etc. Profiting from flexible forms of participation (Joyce, 2007), la Quadrature is open for any input from occasional contributors and counts on the periodic mobilization of supporters to call MEPs or participate in the internet blackout[8]. The group welcomes more active participation in the organization of the campaign itself.

It is difficult to estimate how many supporters la Quadrature can count on. As in most internet-based groups, a core of very active members produces most of the content while up to 90% are so-called “lurkers” (Nonnecke & Preece, 2000). Nonetheless, the boundaries between these various contributors is far from impermeable – core activists can put their activities on hold for a certain period of time and become occasional supporters, just as lurkers can decide to join the IRC discussions and move closer to the core of the group. The rule of thumb is that any person is encouraged to contribute and those who bestow a considerable amount of time and show the strongest analytical skills emerge naturally as leaders. Additionally most core activists hold a record in past legislative battles surrounding intellectual property rights at the national and European level.

From 1998 onwards, the debate around the possible introduction of software patents in Europe generated widespread awareness among the European FLOSS community (Karanovic, 2009). It sensitized many supporters about the dangers of repressive intellectual property rights legislations as well as the importance to look at the European level, at the origin of two thirds of EU member states legislations. The significance to intervene at the EU level was confirmed when member states transposed the EU copyright directive[9] which forbid the production and distribution of devices that circumvent copyright protections. In France, the DADVSI law[10], transposing the EU copyright directive, led to extensive campaigning by free software advocates (on a comparative perspective upon the software patents and the DADVSI campaigns see Breindl & Briatte, 2009), many of which now support la Quadrature du Net.

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[5] http://www.laquadrature.net/en/who-are-we (last accessed 23/01/2010)
[6] Ibid.
[7] The Open Society Institute (OSI) is the private foundation of the Hungarian-American businessman George Soros, offering grants for the promotion of democratic governance and fundamental rights.
[8] La Quadrature du Net launched an internet blackout, i.e. the voluntary dressing in black of websites, avatars, etc., in order to influence the French three-strikes legislative proposal, the HADOPI law.
[9] Directive 2001/29/EC
[10] Loi sur le Droit d'Auteur et les Droits Voisins dans la Société de l'Information, in English: Law on Authors' Rights and Related Rights in the Information Society.

Most (but not all) core campaigners and supporters are male, hold a university degree, aged between 20 and 35 and live in urban areas. They are technology-savvy, many holding degrees in computer science, and showing affinities with the FLOSS movement and free culture ideas such as promoted by Lawrence Lessig.

Their working attitude is very focused, pragmatic and reveals an “engineering philosophy to 'make things work'” and an “insistence on adopting a technocratic approach to solving societal problems and to bypassing ('hacking') legislative approaches” (Berry 2008, p. 102). If there are “harmful” amendments within a French legislative proposal or within a set of five European directives, everything needs to be done to “patch”[11] the texts just as you correct a mistake in a computer program. The political process is conceived of as a “technocratic system” (Activist, Interview 1, Brussels, February 2008) that can be modified by applying reverse-engineering principles, the throughout analysis of its structure, function and way of working (Delalande, 2009), and a “pragmatic approach towards implementing stuff, by doing stuff and problem solving” (Activist, Interview 1, Brussels, February 2008).

Most core activists are more or less closely linked to the free/libre and open source software movement (FLOSS), either as programmers, free or open source software company owners or users. For many activists, the advent of computers and the internet is a revolution that is fundamentally altering the current power balance (cf. Rebentisch, 2005 at the start of the paper). However, dominant actors, like the entertainment industry, threaten the open architecture of the internet in order to secure their profits. Inspired by open source principles, la Quadrature du Net wishes to counter such drawbacks. In the next section we will examine more closely the Telecoms Package campaign, before analyzing their action repertoire and discussing the relations between it and their underlying philosophy of openness.

The Telecoms Package Campaign

The adoption or reform of a European directive, following the co-decision procedure, requires the agreement of both the European Parliament (EP) and the Council of the EU. On November 13, 2007, the European Commission proposed a first set of amendments to reform the five directives[12], that compose the EU Telecommunications Rules of 2002. The amendments were then discussed at Committee stage[13] in the EP where new amendments were introduced before being voted during the EP’s first reading on September 24, 2008. The Council of the EU rejected some of the amendments introduced by the EP, which led to a second reading on May 6, 2009 that was prepared by frequent negotiations between the three institutions and further committee amendments. On May 6, 2009 the EP adopted the texts on which a compromise had been reached with the Council of the EU, except for one known as “amendment 138”. Amendment 138 was tabled by MEPs from various political groups and countries and adopted by 88% of all MEPs in the first reading. In its original version, it reads

[11] “A patch is a small piece of software designed to fix problems with or update a computer program or its supporting data.” (Wikipedia “Patch,” http://en.wikipedia.org/wiki/Patch_(computing) (last accessed March 30, 2010)

[12] Access Directive 2002/19/EC, Authorisation Directive 2002/20/EC, Framework Directive 2002/21/EC, Universal Service Directive 2002/22/EC and Privacy Directive 2002/58/EC.

[13] The Committees in charge were ITRE, IMCO, LIBE, CULT, ECON and JURI.

"no restriction may be imposed on the fundamental rights and freedoms of end-users, without a prior ruling by the judicial authorities" (at the time art. 8.4.g, Framework directive).

From spring 2008 to November 2009, la Quadrature extensively covered the evolution of the legislative process and was particularly supportive of amendment 138, presented as preventing the introduction of "three strikes" in France where a legislative proposal introducing graduated response was tabled at the same time. Further amendments were problematic to the principle of net neutrality (the indiscriminate routing of content over the internet) or to the respect of privacy in digital realms. Their actions were twofold: at the French level with the HADOPI law[14], and at the European level with the Telecoms Package. On the European level, la Quadrature du Net could count on a wider network of activists present in most member states who would engage their associations and networks during the various mobilizations. Their overall strategy consisted in striving to stop the French HADOPI law by preventing the adoption of any amendment that would allow "three-strikes" to be legalized at a European level. If possible, la Quadrature hoped to reject "graduated-response" at the EU level so as to cut short the French legislative proposal before this one was adopted.

At the outset of the reform, amendment 138 and references to "three strikes" or Net neutrality were not supposed to be in the Telecoms Package. The five directives under reform covered a wide range of issues aiming at increasing the competitiveness of the EU telecommunications market, such as the establishment of a European regulatory authority[15], the management of radio and television spectrum, the stimulation of next-generation networks as well as issues of privacy, security and consumer protection. However, the agendas of the French HADOPI draft law and the reform of the Telecoms Package run in parallel and the heated debates at the French level soon spilled over to the EU process.

The adoption of the original version of amendment 138 by the EP's second reading led to a further extension of the legislative process. On November 24, 2009, the EP and the Council finally reached an agreement on a modified version of amendment 138 that replaces "prior ruling by the judicial authorities "by prior fair and impartial procedure"[16]. The compromise removed the reference to the compulsory implication of a judge, which would have lengthened the procedure that can now be carried out by an administrative authority. Furthermore a declaration by the European Commission on Net neutrality was added, promising to work on this issue during 2010.

During the eighteen months of the Telecoms Package campaign, la Quadrature launched a series of actions. These included for instance frequent press releases, analyzes of the contested aspect of the package that were posted online, send to MEPs and to journalists,

[14] Loi n°2009-669 du 12 juin 2009 favorisant la diffusion et la protection de la création sur internet. In English: Law n°2006-660 of June 12, 2009 facilitating the diffusion and protection of creation on the internet. HADOPI stands for Haute Autorité pour la Diffusion des Oeuvres et la Protection des Droits sur Internet, or High Authority of Diffusion of the Art Works and Protection of the (Copy)Rights on the Internet.

[15] After long negotiations between member states, the EP and the Council agreed on the establishment of a new EU Telecoms agency, BEREL (Body Regulators for Electronic Communications)

[16] http://www.laquadrature.net/wiki/Telecoms_Package_Amendment138_compromise_20091105 (last accessed 23/01/2010)

mobilizations of citizens to contact their MEPs either by phone, e-mail or by a postcard action during the 2008 summer months. In order to help and encourage citizens to contact their MEPs, la Quadrature provided example letters, questions to ask MEPs and advice on how to write to a political representative, insisting on the importance of sending personal messages and no standard texts. A benevolent supporter of la Quadrature also wrote a script, Political Memory, listing all MEPs and their voting behavior during previous votes considered as relevant by la Quadrature (see below).

Interviews with several advisors and members of the EP showed that these online actions resulted in repeated emails, phone calls and letters to MEPs as well as growing media attention regarding this particular amendment. All of the persons encountered inside the EP, whether allies of la Quadrature or holding opposite views, attested of their influence on the legislative project with “reflections of the campaign all over the adopted Telecoms Package” (EP committee staff, Interview 32, Brussels, January 2010). A scrutinized analysis of the precise effect of this campaign is beyond the scope of the paper. The point we wish to make here is that internet-based activism can have a clear impact on EU decision-making. The following section will analyze more closely the various tools used by la Quadrature for sustaining their claims and analyze the way in which they mirror the culture of open source they are part of.

Open Source as an Action Repertoire

Next to mailing lists, emails, and IRC channels, la Quadrature du Net relies primarily on its main website (fig. 1) as its central platform for distributing information to interested individuals. The website presents the collective, the challenges at stake and offers frequent news updates, press releases and analyzes written by la Quadrature activists. The website links directly to the wiki via a tab and indirectly via the tools section. A core activist distinguishes these sites in the following words:

> “We use two types of sites: production sites, let’s say sites that are content management sites for the editorial communication, so that’s where a small number of people have editing rights on these sites, and wikis for things that need to be the most agile in editing, for example, we use wikis essentially for what we call mobilizational pages.” (Interview 13*, Paris, May 2009[17])

The website is the primary showcase of la Quadrature and the claims they defend. It lists frequent updates concerning the Telecoms Package as well as the French HADOPI law and related legislative texts. The website is bilingual, French and English. The organization of the campaign the translations are managed via their to-do list[18], IRC discussions and frequent email exchanges.

[17] Interview quotes with an * are translated from French by the author.
[18] http://www.laquadrature.net/todo (last accessed 23/01/2010)

Figure 1: Screenshot of the English version of La Quadrature du Net's website[19]

In terms of Stein's typology of communicative functions of web-spaces presented in section 1, la Quadrature's website and wiki fulfils most of these: they provide information, promote interaction and dialogue, assist action and mobilization, make lateral linkages, serve as outlets for creative expression, and aim to generate further resources for the campaign (2009, p. 752-753). These functions are interrelated in practice yet gain from being distinguished here for heuristic reasons. As generating resources has been largely absent from the Telecoms Package campaign[20], it will not be examined here along with the five previous functions identified by Stein.

Information: La Quadrature seeks to increase the informational transparency and openness of political decision-making. Both the wiki and the website aim to inform citizens about the Telecoms Package (and other issues not discussed here). Frequent press releases keep interested individuals or groups up to date on the latest developments concerning the Telecoms Package. La Quadrature publicizes information they have obtained from inside the EP and take position on the process. They also want to ease the access to the Telecoms Package text in itself. A benevolent founder of la Quadrature du Net developed LawTracks[21] (fig. 3), an open source tool that allows any internet user to compare different versions of Telecoms Package articles considered as problematic by la Quadrature.

[19] http://www.laquadrature.net/ (screenshot taken on 20/01/2010)
[20] Generating resources has not been a central component of the Telecoms Package campaign which was supported by an OSI funding as explained above. This aspect will therefore not be developed in more detail below.
[21] http://www.laquadrature.net/lawtracks/Telecoms_package/ (last accessed on 20/01/2010)

Figure 2: Excerpt comparing the three institutions' changes to the Telecoms Package using LawTracks[22]

Proposal for a Directive of the European Parliament and of the Council amending Directives 2002/21/EC on a common regulatory framework for electronic communications networks and services, 2002/19/EC on access to, and interconnection of, electronic communications networks and services, and 2002/20/EC on the authorisation of electronic communications networks and services (COD/2007/0247)

Directive on access to, and interconnection of, electronic communications networks and associated facilities (Access 2002/19/EC)

Article 9

European Parliament First Reading	Council of European Union Common Position	European Parliament Second Reading
Article 9 – Obligation of transparency	**Article 9 – Obligation of transparency**	**Article 9 – Obligation of transparency**
1. National regulatory authorities may, in accordance with the provisions of Article 8, impose obligations for transparency in relation to interconnection and/or access, requiring operators to make public specified information, such as accounting information, technical specifications, network characteristics, restrictions on access to services and applications, traffic management policies, terms and conditions for supply and use, and prices.	1. National regulatory authorities may, in accordance with the provisions of Article 8, impose obligations for transparency in relation to interconnection and/or access, requiring operators to make public specified information, such as accounting information, technical specifications, network characteristics, ~~restrictions on access to services and applications, traffic management policies,~~ terms and conditions for supply and use, ***including traffic management policies,*** and prices.	1. National regulatory authorities may, in accordance with the provisions of Article 8, impose obligations for transparency in relation to interconnection and/or access, requiring operators to make public specified information, such as accounting information, technical specifications, network characteristics, ~~restrictions on access to services and applications, traffic management policies,~~ terms and conditions for supply and use, ***including any conditions limiting access to and/or use of services and applications where such conditions are allowed by Member states in conformity with Community law,*** and prices.
2. In particular where an operator has obligations of non-discrimination, national regulatory authorities may require that operator to publish a reference offer, which shall be sufficiently unbundled to ensure that undertakings are not required to pay for facilities which are not necessary for the service requested, giving a description of the relevant offerings broken down into components according to market needs, and	2. In particular where an operator has obligations of non-discrimination, national regulatory authorities may require that operator to publish a reference offer, which shall be sufficiently unbundled to ensure that undertakings are not required to pay for facilities which are not necessary for the service requested, giving a description of the relevant offerings broken down into components according to market needs, and	2. In particular where an operator has obligations of non-discrimination, national regulatory authorities may require that operator to publish a reference offer, which shall be sufficiently unbundled to ensure that undertakings are not required to pay for facilities which are not necessary for the service requested, giving a description of the relevant offerings broken down into components according to market needs, and

A link to the software used for generating this database explains furthermore how it can be installed and adapted – freely – for other uses. The original texts of the directives are extracted from EUR-Lex, a European platform that provides free access to EU law texts[23]. These texts are available in the four official EU working languages (English, French, German and Spanish) but further translations can be added.

Interaction and dialogue: discussion is at the base of how la Quadrature du Net takes its decisions, generally on their IRC channel or on mailing lists. This means that any interested individual can intervene in the discussion, propose his analysis of a legislative aspect or give an advice on how to lobby a particular MEP. Discussion is not encouraged on the website or wiki as no comment places are provided. This is due to the fact that their purpose is mainly informational. Nonetheless, contact numbers are provided to reach core campaigners and a link invites supporters to join the mailing list or the IRC channel.

Action and mobilization: Enabling the participation of persons is a central component of La Quadrature's activities. Citizens are asked to participate in various ways. They can contribute to la Quadrature by looking at their wiki page 'How to help'[24], which lists the most recent tasks that need to be done. These include completing and improving the wiki, updating and facilitating navigation, improving the internet site, relay the message by talking to family, friends and colleagues about la Quadrature and of course spreading the word on the internet via social media icons present underneath each article, contributing to the press review, translating pages, taping videos and analyzing them, as well as generating logos, web buttons

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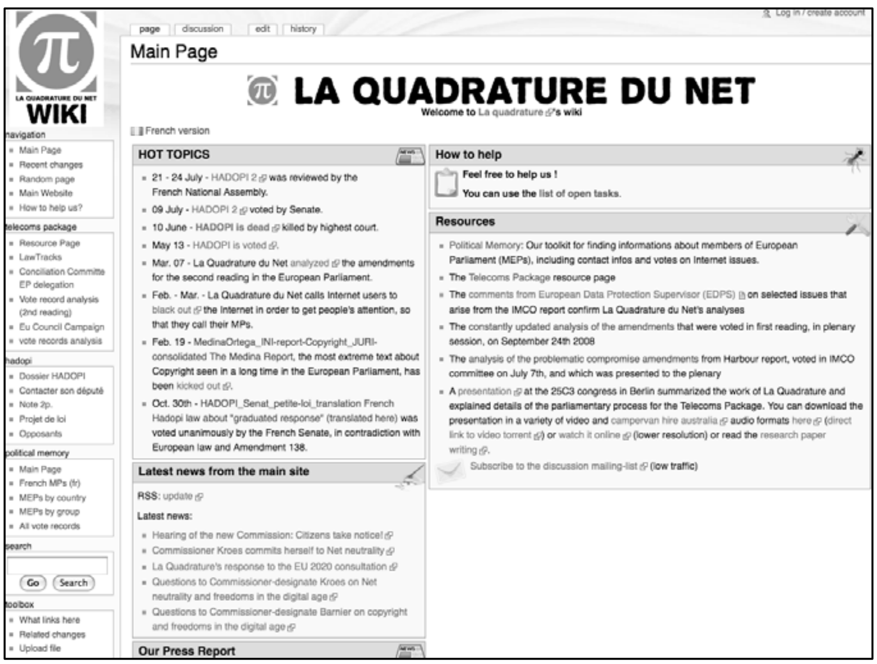
[22] http://www.laquadrature.net/lawtracks/Telecoms_package/ (screenshot taken on 10/01/2010)
[23] http://eur-lex.europa.eu/en/index.htm (last accessed on 20/01/2010)
[24] http://www.laquadrature.net/wiki/How_to_Help (last accessed 23/01/2010)

or banners[25]. For more information, visitors are invited to join the discussion on the various IRC channels of la Quadrature.

The wiki offers a central platform for engaging supporters in the organization of the campaign. It is licensed under a GNU Free Documentation Licence 1.2 powered by MediaWiki (like Wikipedia). It offers latest news on the evolution of the decision-making process la Quadrature is interested in. Its main function is however to serve as the resource page for preparing the campaign. One core activist explains its use:

> “The wiki is a completely central tool. We use the content management Drupal that allows to quite finely pass one after the other to edit, change, make revisions, compare revisions, tag, publish the press review in which we put, as you might have seen, all the articles. The ones that talk about us, the ones that quote us... that helps afterwards to extract the list of the most important stuff for the financials, to show them how we work or things like that. And everything is intimately linked of course to the use of these web tools.” (Interview 12*, Berlin, April 2009)

Figure 3: Wiki Site of La Quadrature du Net [26]



The wiki enables flexible participation (Joyce, 2007) although only a small number of persons participate in practice:

> Interviewee: As soon as we have the amendments,... already we have the amendments as early as possible,... we hurry to produce an analysis as early as possible to put it on the wiki, so that people participate already. In reality, it’s 80% ourselves who do it and people will maybe come edit the two things that interest

[25] http://www.laquadrature.net/wiki/Comment_aider (last accessed 23/01/2010)
[26] http://www.laquadrature.net/wiki/Main_Page (screenshot taken on 20/01/2010)

them or change a spelling mistake or stuff like that but they have the possibility to do it.

Interviewer: Who? Anybody?

Interviewee: It doesn't matter whom. Anyway, we see the modifications so we can always come back if it doesn't please us.

(Interview 12*, Berlin, April 2009)

The type of participation promoted by la Quadrature is similar to the collaborative development model of free and open source software projects. People with an interest in joining are free to do so and a person is judged upon his analyzing or programming skills, not on his professional or social status. The result of this collaborative work is then shared with any person who would like to access or use it. Sharing is generally promoted by open source culture.

Lateral linkages: La Quadrature du Net uses hyperlinks to refer to various other sources: mainstream news coverage of the Telecoms Package and their campaign, and the websites of like-minded associations and groups, which support their activities. Their press releases always link to the sources where the information comes from, frequently official reports.

Next to LawTracks, la Quadrature uses another open source tool: political memory accessible via their wiki. Political memory started off as a memory-help for one of the activists. The tool lists all MEPs and their voting behavior on reports and directives la Quadrature is concerned with. Initially designed for personal use, political memory developed into a toolbox intended to help citizens to keep track of what each MEP voted and expressed in a plenary debate for example, associated with a Quadrature rating on how favorable the vote is to their positions. Political memory is intended to help citizens contact their MEPs, listing all the necessary contact information and offering a search interface for finding an MEP. Every time an MEP is referred to in an online document, a hyperlink connects directly to the political memory interface for further information on and contact details of the political representative.

Creative expression: Creativity is an important principle put forward by la Quadrature. People are encouraged to contribute as they see fit and by letting their creative expression guide their individual actions. In sum, la Quadrature considers itself a "toolbox" as one core campaigner explains:

"Me what I like most actually, it's to be a toolbox, to allow people to understand what is happening and to allow them to act, to give them the tools to act." (Interview 12*, Berlin, April 2009)

During the Telecoms Package campaign, la Quadrature du Net encouraged citizens to create their own banners and spread the message in any form they liked. The claims and tools used by la Quadrature reveal an underlying philosophy of doing, as one supporter explains:

"Tools like LawTracks, comparison tools of the various phases of a text, or tools like political memory that try, let's say to memorize and to make available the action of various members of parliament of different countries... I believe there is an innovation component that matches our culture of doing, of action let's say but not to do whatever but to produce, that presumably finds its source in the free software movement but that inhabits a wider space today" (Interview 13*, Paris, May 2009).

The link to the FLOSS movement is also clear when examining the use of so-called Web 2.0 platforms by la Quadrature activists. There are no overarching guidelines on which tools should be used so every supporter can use a variety of different platforms. Some, like Facebook, are however contested by core campaigners of the group. The use of personal data and the protection of privacy are of concern to various supporters who refuse to create a Facebook account. La Quadrature uses a Facebook page, created by a supporter, which is regularly updated with their latest news. However, none of the core activists uses it. Similarly, the open source microblogging site identi.ca is preferred to the use of Twitter, some supporters using both by linking their Twitter profile to identi.ca. For one core activist:

> "Actually, whether it's for these Web 2.0 tools or even blogs, at the end there is little difference with what you can do with the internet since its beginning. Simply, there are more tools that make things easier for people who do not know, who do not write HTML code or things like that. Then, even for people who know how to write, after all it's more productive to write directly a blog page than to write an HTML page" (Interview 20*, Paris, November 2009)

The philosophy of open source informs the content as well as the tools used by la Quadrature. This leads to innovative approaches, such as the creation of tools for facilitating the monitoring of the decision-making process, but also leads to the non (or only partial) adoption of some applications, such as the social networking site Facebook, considered as conflicting with the FLOSS principles that inspire Quadrature du Net activists.

Discussion

La Quadrature du Net's Telecoms Package campaign provides a rich empirical ground to further the academic debate on "new" forms of internet-based activism and its relation to open source principles. The case study presented in section 4 shows how la Quadrature used various internet tools in order to intervene on a complex set of European directives regulating the telecommunications market.

The values of the citizen collective are based on a particular conception of what the internet is, a decentralized network enabling citizens to participate and express themselves freely. As such it needs to be safeguarded when threatened by legislative reforms such as copyright or network regulations. La Quadrature promotes principles of freedom, participation, openness, transparency, sharing and access to information that are embedded both in the claims they support and the tools they use.

Regarding freedom, la Quadrature fights against repressive regulations that might harm the "architecture of participation" built in the internet. They consider the internet as a revolution as important as the invention of the printing press by Gutenberg. For Benjamin Bayart, a supporter of la Quadrature, “the printing press allowed people to read, the internet will allow them to write”[27]. Freedom of expression but also freedom to create and the protection of privacy and equality in the access to internet services are core values upheld by la Quadrature activists.

Participation and collaboration are the founding principles of how la Quadrature works. Just as many internet-based movements, they take advantage of the internet for reaching out to citizens, inform and debate at relatively low costs. Yet, contrary to other protest groups, they fully exploit their technological skills in order to involve like-minded people in the very organization of the campaign. The majority of the campaign work is however accomplished by core activists, most of whom contribute on a voluntary basis.

An important aspect of la Quadrature’s work is to improve the openness and transparency of policy making. They do not only defend principles of openness but work to improve the transparency of EU decision-making. Tools such as LawTracks or political memory are direct consequences of this aim. This is a particularly important challenge posed to EU decision-making, often criticized for its inherent democratic deficit. La Quadrature furthermore works to sustain the power of the European Parliament, the only directly elected body of the EU, towards other entities such as the Council of the EU or the European Commission.

The action repertoire of la Quadrature is informed by free and open source principles. Everything that is produced by the activists is meant to be shared with any interested person and thus made widely accessible online. Furthermore, they also publish information that is already available elsewhere – on European Union internet sites for instance – and pay special attention to the use of open formats. Increasing the access to information of individual citizens is an overarching aim of their actions.

Furthermore, the attitude towards technology defended by la Quadrature activists is close to the hacker culture. They have a wide array of digital skills at their disposal and use technology as a means to open up the political process. Compared to other forms of internet-based activism, they represent a particular and rather effective strand. Yet, mobilizational challenges are not overcome by the sheer use of the internet. Difficulties to make their voice heard and to engage citizens in their actions remain characteristic of any type of activism.

Their campaigns are not only technology-mediated. Internet use is certainly a central aspect of la Quadrature, but being present inside the European Institutions is even more crucial for convincing decision-makers and obtaining information that can be redistributed online.

Finally, the paper shows that the internet has become a central place, tool and object of political battles. Activists defending open source principles are eager to defend their particular vision of a free and open internet architecture. In order to do so, they intensively rely on internet-based tools and arguments that lead to the confrontation of particular know-hows, habits and ways of thinking that used to be reserved to experts and technicians (Riemens, 2002) with traditional decision-making practices.

[27] http://www.ecrans.fr/L-imprimerie-a-permis-au-peuple-de,8351.html (last accessed 22/01/2010)

Future Research

This case study has shown how open source informs both the claims and the action repertoire of a new type of internet-based activism. Further research is however needed to explore such phenomena in more detail. We notably argue for a comparative study of open source protest groups in various contexts. Indeed, most Western countries, but also developing ones, are confronted to changes in intellectual property rights legislations. The current negotiations surrounding the Anti-Counterfeiting Trade Agreement (ACTA) between various countries, the Telecoms Package reform and the French HADOPI law show that such regulations are taking place on various levels of decision-making and in various countries. Internet-based actors such as la Quadrature du Net are often involved on all these levels, trying to build transnational networks with like-minded activists. Research will need to further assess to what extent one can speak about a free culture or open source movement regarding such activism. La Quadrature du Net's Telecoms Package campaign is not an isolated event but takes place in a larger context of power struggles. Further studies about the philosophy underlying such actions, the tools they use, the way they organize and interact with "traditional" structures are necessary to understand current trends in 'glocalised' societies.

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Where the Cathedrals and Bazaars Are:
An Index of Open Source Software Activity and Potential

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Abstract

This paper presents a framework to measure activity and potential for open source software development and use at a country level. The framework draws on interviews with experts in the open source software industry and numerous existing studies in the literature to identify relevant indicators. Several indices of diverse variable lists and weighting and aggregation methods were developed and tested for robustness. The results provide a first step toward more systematically understanding the current state of open source software internationally.

Keywords: open source software, index construction, technology policy, technology diffusion

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Introduction

Open source software (OSS), also known as Free/Libre/Open Source Software (FLOSS), presents an important case of innovation in software production and distribution. The voluminous literature on OSS includes Steven Weber's (2005) *The Success of Open Source* and Joseph Feller et al.'s (2007) *Perspectives on Free and Open Source Software* in addition to various other works (e.g., Hahn 2002, Weber 2005, Dibona et al. 2005, Bitzer and Schroder 2006, Ghosh 2006). Raymond's (1999) seminal work on OSS portrays a dichotomy between proprietary software and OSS as a cathedral and a bazaar, respectively. The analogy plays on the systematic and revered construction of a cathedral (for proprietary) versus a buzzing bazaar full of decentralized activity (for open source). This paper advances scholarship on the distribution of the bazaar on a global scale by adding empirical detail to the ever-growing literature on both the theory of OSS and its firms and developers. The analysis provides more information about the development, adoption, and diffusion of OSS technology and methods. This initial inquiry into its prevalence should inform the ever-increasing debate and scholarly interest in OSS.

The decision to implement technologies and technological processes is a function of a range of social, economic, and political variables. The involvement of governmental policymakers and regulators, both at the national and sub-national levels, is a critical factor in the deployment and adoption of technologies, both explicitly (in terms of specifications, technical standards, requirements for adoption, etc.) as well as implicitly (the apparent favoring of a technology by government officials as a "pull" factor). This present inquiry maps out the terrain of OSS activity and measures factors that drive OSS potential. Developing a standardized heuristic (in this case, an index) for assessing a country's adoption of OSS can inform future inquiries into both the causes and consequences of where a country falls on a "cathedral-to-bazaar" continuum.

To develop an index of OSS, a conceptual model is introduced that draws a distinction between OSS activity levels and the potential for OSS development. The conceptual model draws on interviews with experts in the OSS industry and numerous studies in the literature to identify relevant indicators. Section 2 describes this literature and expert opinion underpinning the index framework. Section 3 outlines the data collected. Section 4 discusses the construction of indices for robust measurement of OSS activity and potential at a national level. Section 5 reports the results for the OSS indices and sensitivity tests. The final section discusses the broader implications.

Background

Literature

While a variety of different approaches exist for the design of an instrument such as an open source index, generally improved validity flows from a systematic examination of supporting literature. In order to devise an index, relevant insights and themes were culled from the existing literature and interviews with software industry experts who specialize in OSS. The results of this literature review are summarized next.

In addition to technological issues, social, cultural, and policy issues also impact OSS diffusion and adoption (Gosain 2003, Lin 2006, Vaisman 2007, Lewis 2008). The social and policy sciences might be said to have arrived relatively late to the "OSS party." This may be due, in large part, to the paucity of relevant data on the OSS. Ghosh (2007) explains why little empirical evidence exists for explaining why or how the open source model works. Hard data on the monetary value of OSS collaborative development is almost non-existent. This limits economic evaluations, and non-economic activity such as the creation and development of free software is hard to measure in any quantifiable sense. Ghosh contends, therefore, that the lack of objective, "census-type" sources means that many indicators, quantitative and qualitative, may require the use of surveys, which can be costly and unwieldy. Again, with respect to the development of a robust global open source index, the availability of accurate data sources for a wide range of countries is a critical factor in this emerging research area. A number of social scientists have observed the critical data constraint facing this research area (Van Wendel de Joode et al. 2006).

The calls for more social science and policy research into OSS have been numerous. Weber (2000) identifies three key issues for social scientists to investigate: (1) motivation of individuals who develop open source; (2) coordination of activities in the supposed absence of a hierarchical structure, and (3) growing complexity in open source projects and its management. While the purpose of this analysis is to better portray the landscape of OSS activity globally, these issues—in particular the research on motivation (e.g., David and Shapiro 2008, Krishnamurthy 2006, Lerner and Tirole 2005b)—indirectly inform the design of the indices and the selection of indicator variables.

Several themes consistently emerge from the literature. First, technology adoption at the national (country) level is often emphasized. Second, analyses of public-sector OSS adoption usually focus on relevant policy issues. Third, literature on the private sector rarely goes to level of the individual firm. Beyond these issues of adoption, the literature routinely recognizes developer roles in adoption and use. Finally, and almost universally, economic issues pertaining to open source software capture the attention of researchers, but study is still impeded by a lack of quantitative evidence.

Adoption at national (country) level: Scholars have examined the adoption of open source by national governments, particularly through the passage of laws and regulations. By 2001, Peru, Brazil, Argentina, France, and Mexico all had measures pending that would mandate the use of open source software on government computers (Lewis 2008). Other national and sub-national efforts were made in countries such as Germany, Spain, Italy, and Vietnam to establish official alternatives to the use of closed, proprietary software by government (Lewis 2008). When considering open source adoption at the national level, one key issue is governmental, educational, and "third-sectoral" interests in pursuing this option.

Public Sector Adoption and Public Policy Issues: Whereas some governments have begun to *procure* open source software, others, such as Japan, Korea, and China, have actually channeled public funds to large-scale open source development projects (Chae and McHanney 2006). The distinction here, as made by Lee (2006), is that a nation that "considers" OSS signifies its desire to establish a level playing field within the public sector's information technology procurement policies. Such a policy is not necessarily "pro-OSS" because it neither constitutes a government preference for OSS, nor mandates the government to choose it. However, when policy makers decide to "prefer" OSS over proprietary software, the decision is likely to be criticized by proprietary software developers as procurement discrimination. Other issues germane for policy makers include OSS's impact on e-government initiatives. Berry and Moss (2006) discuss circumstances in which the discourse and practice of non-proprietary software contribute to e-government's openness and democratization. OSS can protect and extend transparency and accountability in e-governments, as well as offer opportunities for citizens, non-governmental organizations, public administrators, and private firms to socially shape OSS's direction. Finally, policy issues such as standards settings and open licensing, both of which structure the deployment of open source software, are inherently political processes that also impact technological choices (Simon 2005, Seiferth 1999).

Private Sector Adoption and Use: Within national contexts, the private sector, specifically any firm reliant on information technology, still remains an important stakeholder group when considering the opportunities and barriers to the adoption of open source. Notably, Bonaccorsi and Rossi (2006) call attention to the factors informing private sector decisions about whether to embrace or reject open source. Considerations include economic (price and license constraints), social (conforming to values of OSS community), and technological (exploiting feedback and contributions from developers, promoting standardization, security issues) motivations.

Role of Developers in Adoption and Use Decisions: The motivations of open source developers in the literature have generally been explained in the literature through a taxonomy that considers two components of motivation—intrinsic (e.g., fun, flow, learning, community) and extrinsic (e.g., financial rewards, improving future job prospects, signaling proficiency to others) (Lerner and Tirole 2005a). Krishnamurthy (2006) identifies four important mitigating and moderating factors in the conversation surrounding developer motivation: (1) financial incentives, (2) nature of task, (3) group size, and (4) group structure. Such issues are important because the motivations of open source developers shape socially the adoption of these systems by firms and governmental agencies. Lin (2006) argues that open source development entails a global knowledge network, which consists of: (1) a heterogeneous community of individuals and organizations who do not necessarily have professional backgrounds in computer science, but who have at least developed the competency to understand programming and work within a public domain, and (2) corporations, which results in a hybrid form of software development and distribution.

Economic Issues Pertaining to Open Source Software: Much of the literature on OSS adoption involves the work of economists, many of whom are intrigued by OSS's distinctive mode of technological development, innovation, and distribution, especially its non-proprietary and community-based nature. Lerner and Tirole (2005a) suggest four major issues of interest to scholars studying open source software: (1) technological characteristics conducive to smooth open source development, (2) optimal licensing of open source, (3) the coexistence of open source and proprietary software, and (4) the potential for the open source model to be carried over to other industries. Forge's (2006) analysis of the packaged software industry extends Lerner and Tirole's third point in the context of European economic development, where encouraging OSS may provide a strategic counterbalance against concerns that a few, select proprietary software firms exert excessive market power.

Expert Interviews

A series of in-depth interviews with OSS experts and professionals were conducted in order to inform the design of an index measuring OSS activity. This critical source of insight was gathered from a variety of informant sources via semi-structured interviews conducted jointly by the authors. The interviews were performed in person and, for international informants, via telephone, and each lasted between 30 and 90 minutes. Over a dozen informants were selected from a variety of leadership roles (directors of developer relations, regional markets, legal affairs, policy) within a major international open-source software firm. Building on their cooperation, the interview team then contacted a dozen foreign IT professionals with expertise in the OSS arena, with regional representation including Brazil, Chile, Costa Rica, Mexico, France, Germany, Spain, India, China, the Middle East, Australia and the South Pacific. The interviews discussed such matters as what constitutes OSS activity, on what scales OSS activity can and should be measured, and what facilitates or hinders OSS development and adoption. There was considerable variation in the answers received, even from people within the same organization. Follow-up questions helped to reconcile the variety of responses and start to build a "modal" conception of OSS activity, what composes its critical dimensions, and how to make an index most useful to the professionals and experts in the arena. Quite interestingly, there was strong sentiment among stakeholders for making the index (of open source activity) itself "open source." Keeping the construction of the index transparent, using only public and accessible data sources, and allowing for subsequent modification by the user community were seen as vital elements to any OSS index. The authors agree with this rationale on the grounds that the Index described here will be open to further study and improvement.

Index Design: Conceptual Issues

The design of an open source index poses several interesting challenges. First is the tension between actual, observed OSS activity and latent, potential OSS activity. Both OSS activity and OSS potential have received attention in the scholarly literature, especially whenever questions arise about the future of OSS, the success of OSS relative to proprietary software, or areas where OSS (or institutions or policies) is seen to lag in comparison to other countries or regions. The distinction between active OSS development and adoption versus the potential for such also arose during the expert interviews. Hence, the authors have addressed this dichotomy by developing two different indices, one capturing "activity" (conceptually similar to adoption) and the other capturing "potential" (roughly related to propensity or capacity) in OSS. The open source activity index (A) and the open source potential index (P) are constructed in parallel fashion. The following section describes the basic construction including operational concepts, selection and categorization of variables, and design considerations for modularity and aggregation.

The open source indices are each composed of dimensions, indicators, and variables. Figure 1 depicts this generic structure. The three *dimensions* of both the Activity Index and the Potential Index are composed of government, firm, and community categories. Each dimension is then operationalized by *indicators*, which are generated by a transformation or aggregation of the actual underlying *variables* (data). Each variable in the inventory of data sets is therefore linked to the dimensions via indicators. Of course, an alternative index could employ more, fewer, or different dimensions. These three dimensions[1] emerged consistently from the expert interviews, and most published research on the social and policy aspects of OSS connects closely to at least one of these dimensions. A lengthy candidate variable list is based on the theoretical issues from the literature, consideration of insights and observations from expert informants, and data availability. To develop a global index (rather than just for OECD nations, for instance), with a prerequisite that data be publicly accessible, the data availability criteria proved particularly limiting.

Figure 1: Generic index construction

$$\text{INDEX} = f_1(\text{Dimension}_1, \ldots, \text{Dimension}_i, \ldots, \text{Dimension}_I)$$

$$\text{Dimension}_i = f_2(\text{Indicator}_1, \ldots, \text{Indicator}_j, \ldots, \text{Indicator}_J) \qquad \forall\ i=1,\ldots,I$$

$$\text{Indicator}_j = f_3(\text{Variable}_j) \qquad \forall\ j=1,\ldots,J$$

A second design consideration relates to both transparency and modularity in the construction of the index. Each candidate variable for inclusion in an index must be identified for a reason; therefore, it is linked to either the Activity or the Potential index. It is also categorized based on one of the three dimensions: government (*G*), firms (*F*), or community (*C*). Each variable is further categorized as being either a direct variable (related to or impacting OSS specifically) or an indirect, contextual variable (e.g., GDP, employment by sector, civil liberties). More direct variables are often preferred because of their closer relationship to OSS, although they are scarcer and limited in the number of countries they cover. Both academic researchers and expert informants recognize these data limitations and regularly employ or recommend indirect variables to describe OSS activity and potential until better data is available. The indices here do likewise in a transparent fashion. Finally, each variable is also categorized as either a ratio or interval measure, for reasons explained below.

A third major design concern relates to the aggregation and "weighting" of variables. In terms of Figure 1, choosing the f_1 and f_2 functions are critical to the index performance. Without some externally validated model to impose structure and weights on the combination

1 The government dimension included issues of policy and procurement, legal standards, property rights and IP law, civil liberties and democracy and corruption in governance, R&D funding, treaty participation, and other policies. The firms dimension involved commercial enterprises, generally speaking, as well as the broader economy, the ICT infrastructure and workforce, prosperity, and de novo economic and infrastructural growth. The community dimension includes primarily educational attributes like the human capital of the population, computer literacy and training (in CS or in OSS specifically), and the cultural affinity for OSS participation.

of the indicator variables, the design choices by the authors may seem arbitrary. This is a risk facing all such indices, such as the Human Development Index used by the United Nations, the Civil Liberties Index of Freedom House, or the Body Mass Index. In recognition of this important concern, the approach here takes several steps to address possible arbitrariness in construction. First, the index construction is based on an extensive review of the relevant literature and on in-depth interviews with numerous stakeholders. The literature review and interviews were conducted to reveal the relative importance and interrelationships of various themes identified above. Second, several alternative models for the open source index are developed here—each with substantively different designs—allowing for tests of correspondence in index values across alternative models (a type of convergent validity check). If the alternative models yield largely similar results from the index, this lends confidence that the index is not merely an artifact of some arbitrary design choices. The alternative models might best be thought of as experimental approaches to designing a practical open source index. Third, the index construction is fully transparent and replicable by others, inviting everyone to test for sensitivity and make improvements.

Lastly, the index construction is influenced by lessons learned in the extensive literature on environmental sustainability indicators. Like the sustainability indices, of which there are over 15 competing and contested variants, the open source indices require constructing novel indices of complex phenomena where relative weights of indicators might be contested. In particular, care is paid to mitigate the sensitivity of index values to arbitrary weighting and aggregation choices made by the researchers, along the lines of Ebert and Welsch (2004). If an index's rankings shuffle greatly because of different indicator weights, variable transformation (e.g., log or raw income), or other aggregation rules, then the index itself becomes suspect without a credible theory dictating the "appropriate" weight, transformation, or aggregation rule in the OSS index. Ebert and Welsch (2004) show how using a geometric mean (unlike arithmetic means) of ratio variables (rather than interval variables) in the index preserves the rank ordering, regardless of the transformations or weights chosen.2 This robustness to arbitrary weighting and transformations is a particularly attractive property of the index, and thus geometric means of ratio variables will be preferred as the f_2 function (see Figure 1) whenever possible.

Index Construction

Open Source Index Models

The following section details the actual construction of the models for the Activity and Potential Indices. We also construct a third index to measure a different OSS-related concept, the ratio of activity to potential *(Ratio = A/P)*, where the resulting value could be interpreted as a measure of "realized potential." Nations with very large *Ratio* values will tend to exhibit more OSS activity relative to what their contextual or environmental factors would predict. (A *Ratio* is available for each pair of *A* and *P* computed.) After some experimentation, several alternative models to construct those indices are proposed here. To indicate the

2 Ratio variables are those that have natural zero values, such as "population" or "number of Firefox installs." Interval variables, on the other hand, do not have natural zeros, such as "degrees Fahrenheit" or "a dummy variable for whether Linux supports the native language."

differences in how the index is constructed, each index is denoted with two subscripts. The first subscript indicates the aggregation rules used (technically, which f_1 and f_2 functions are employed). The second subscript indicates which set of variables is used. Each model captures different aspects of the underlying phenomena and consequently has different advantages and limitations. We first discuss data limitations, variable coverage of countries, variable type designations, and aggregation methods.

Variables and Data Sources

Data limitations.

The OSS indices constructed here employ numerous datasets that are publicly available (with one exception). In a perfect world the indices would draw on a wide variety of datasets populated with systematically, consistently, and comprehensively measured data. Because of the nature of existing international data, however, most variables cover only a limited number of countries and years. In practice, there is a trade-off between the number of countries directly modeled and the range of variables included that span that in turn cover all the countries. Conversely, the larger the number of variables included in the Index the smaller the number of countries for which complete and up-to-date data exist. There are of course several ways in which to deal with this. Future efforts to develop these indices should improve the inclusiveness both cross-sectionally (number of countries) and longitudinally (over time) in the dataset. This is particularly important for the variables directly related to OSS.

Variable coverage (L, S).

To show this trade-off, this paper reports indices for a “long” and a “short” list of countries. Variables are classified according to whether they cover a “short” (roughly $N < 100$) or a “long” ($N > 120$) list of countries. “Short” (S) variables tend to be of higher quality or more directly related to important indicators, whereas “long” (L) variables are more general and only indirectly relate. The index construction recognizes this balance and separately creates “short” and “long” versions of each index—where the latter sacrifices some variable quality in order to obtain greater coverage of countries. In one sense, the comparison is between a higher-quality index measuring OSS activity/potential among relatively “elite” countries and a lower-quality index measuring OSS activity/potential among a more inclusive group.

Variable types (B, R).

Following Figure 1, indices *A* and *P* are computed here using the same general structure: combining multiple dimensions, several indicators for each dimensions, and variables measuring those indicators. Table 1 first shows the various indicators for each dimension. Table 1 also lists the names of the variables chosen for each indicator in the *A* and *P* indices. (Note that the top variable of each pair in a cell is the “long” variable). Variables are further classified according to their nature as interval- or ratio-scale measures and whether they are the best available variable for a particular indicator. The best available proxy for each indicator is listed under that column in Table 1. More direct measures are preferred to indirect measures of the indicator, when available. The best long or short variable may differ for some indicators. Similarly, the best available ratio-scale proxy variable is listed under that column in Table 1. Ratio-scale variables possess useful properties for preserving rank-ordering, as discussed. Logically, the best variable differs from the ratio-scale variable only when the best variable is an interval-scale measure. In general, each set of indicators is drawn from variables that are either best (*B*) or ratio-scale (*R*) and either short (*S*) or long (*L*) depending on how many missing values it has. Thus, there are several variations of each index *A* or *P*, denoted with subscripts either *BL*, *BS*, *RL*, or *RS* to indicate the set of variables used in its construction. Many of the variables are shared across multiple models in this application. Definitions and sources for the variables listed in Table 1[3] can be found in Table A1 in the Appendix.

Additional variables.

Although Table 1 lists the primary variables (those used in all the indices), they are drawn from a much larger pool of candidate variables—each of which is classified similarly (i.e., as long, short, best, ratio, interval) and associated with an indicator. Additional variables, beyond those in Table 1, appear in Table A1. Indices constructed with a weighted average make use of additional variables indirectly measuring OSS aspects of a country, as described below. For instance, the “Firefox users” variable relates directly and “PCs per capita” variable relates indirectly to the household installs indicator (an activity indicator in the Community dimension).

Missing values.

Missing values are prevalent in the datasets used here and, unfortunately, require difficult choices and compromises in order to produce an index. Rather than collect primary data, this analysis occasionally imputes missing data. Because many variables were missing values for most of the countries, imputation is resorted to only in the rare instances when it was both very useful (e.g., imputing a single value meant that the country would not be dropped from the index) and when close proxies were available. Generally, rather than mask this tradeoff through statistical imputation techniques, the trade-off between data coverage (i.e., more countries in the index) and data quality (i.e., more and better variables in the index) is handled transparently in this analysis by reporting both *L* and *S* indices.

A major concern in imputation is that the likelihood of a missing value for a particular country might be correlated with that (missing) value. Using other countries' values to impute the missing value might bias the estimated value if there is something special about the country with the missing observation that makes the countries with complete data non-representative. This is especially likely to pose a problem for international data where, for

[3] Notice the grey-shaded cells, where only 6 out of 46 cells do not have a suitable and available variable at this time. Filling in these blanks is a task for future research. For now, these gaps are minor and need not preclude the construction and testing of these preliminary indices. Only two out of the 23 total indicators have no variables available, and neither affect the potential index.

Table 1: Indicators and Variables Selected

Index	Dimension	Indicator	Best	Ratio
Activity	G	procurement	OSSpolNatman GovExppGDP	GovExppGDP GovExppGDP
		policy	OSSpolNatRD OSSfunding	OSSpolNatRD OSSfunding
		use		
	F	RHCEs & other developers	RHCEpc RHCEpc	RHCEpc RHCEpc
		firms' installs/users	LinuxUserspc LinuxUserspc	LinuxUserspc LinuxUserspc
		firms developing/ supporting OSS		
	C	household installs/ users, Wiki participants	GoogleApp GoogleApp	GoogleApp GoogleApp
		OSS courses, adoption by educators	SchoolNet	SchoolNet
		discussion in media	rOSSnews rOSSnews	rOSSnews rOSSnews
		language supported	LinuxLang LinuxLang	
Potential	G	software policy	nPiracy OOXML	nPiracy nPiracy
		corruption and liberties	nCivLib nCivLib	Turnout Turnout
		e-government	eGov eGov	eGov eGov
		IP law	nTRIPS nIPRI	
	F	IT industry size/competition	ICTtop250pGDP ICTtop250pGDP	ICTtop250pGDP ICTtop250pGDP
		IT growth	newCellGro TelcomInvestpc	newCellGro TelcomInvestpc
		R&D	SciArticlespc RnDemploypc	SciArticlespc RnDemploypc
		I nternet access	nNetPrice nNetPrice	nNetPrice nNetPrice
		de novo growth	inewGrowth inewGrowth	inewGrowth inewGrowth
	C	culture	TVpc TVpc	TVpc TVpc
		education	College GradEngpgrad	College GradEngpgrad
		CS majors	PCspc PCspc	PCspc PCspc
		Internet users	InternetUserspc InternetUserspc	InternetUserspc InternetUserspc

instance, a variable might be available only for OECD countries and, obviously, countries belonging to the OECD differ from non-OECD countries in numerous ways. Imputation is employed here only in instances when a particular county has a missing value in the current (i.e., most recent) year for which that variable is collected and there are earlier observations for that variable in that country. In these cases, a linear imputation is employed in order to estimate what the "current" value for that country would be (using only its prior years' values).

Aggregations

Transformations (f_3) and rescaling.

Most variables are transformed via the f_3 function in order to create the indicators. This initial transformation is critical because the index combines heterogeneous variables with widely varying units of measurement. Combining count variables (e.g., number of applications to Google's "Summer of Code" program) with indicator variables (e.g., country has an OSS procurement policy) and with other types of variables requires transforming or rescaling the original input variables into more commensurable indicators. Similarly, scale effects arising from the variation in sheer size of countries can demand that some variables (e.g., number of Red Hat Certified Engineers) be measured proportional to country size. Without that rescaling, these variables would essentially proxy for country size rather than intensity of OSS activity or potential. Thus, all variables are normalized (i.e., transformed to a Z-score) before entering the index. Any other rescaling is described in the variable definition in Table A1.

Aggregating Indicators (f_2) to obtain dimensions.

After rescaling and normalization (and the few imputations) are completed, the next step is to settle on the f_2 functions that aggregate the multiple indicators into single dimension values. These functions could include an arithmetic mean (*a*), a geometric mean (*g*), a maximum value (*x*), and a minimum value (*i*). Aggregating across different indicators within a particular dimension is also sensitive to instances where a country is missing values for one or more of those indicators. For the minimum, maximum, and arithmetic mean aggregations, missing values for the constituent indicators are ignored and the operation is applied to the remaining indicators (unless fewer than two indicators values existed, in which case the dimension value is also missing).

A fourth type of aggregation function is also considered: the geometric mean. The geometric mean aggregation bears some distinction as being the most robust, in theory, to arbitrary scaling effects for ratio-scale variables (see Ebert and Welsch, 2004, and others). The advantage of geometric mean indices arises when ratio-scale variables are used, thus a *g* index will always imply *R (ratio)* variables. A trade-off arises here because several components of the indices such as measures of "liberty" or "language" are typically only found in interval-scale. For aggregation by geometric mean, the dimension value is assigned a "missing" value if all or all but one constituent indicators have missing values. This geometric aggregation rule limits its sensitivity to holes in the data (although, as a tradeoff, fewer countries can be included in this index).

Aggregating dimensions (f_1) to obtain indices.

The last step in initially constructing the indices involves deciding on the aggregation function f_1 to compile the three dimensions into a single, final index value. Common choices for aggregating the dimensions include arithmetic means (*a*), minimum values (*i*), and maximum values (*x*). Because the dimensions themselves are aggregates of indicators, this 'aggregation of aggregations' permits a large number of combinations of the f_1 and f_2 functions. Five basic combinations are reported here: *aa* (mean-mean, or arithmetic mean of arithmetic means), *ag* (mean-geometric mean, or arithmetic mean of geometric means), *ia* (mini-mean, or minimum of arithmetic means), and *xi* (maxi-min, or maximum of minimums).[4] The first two are our preferred constructions, because they are easiest to interpret (*aa*) and have nice robustness properties (*ag*). The third is the "weakest" dimension, where dimensions are themselves averages. The fourth is the "best" dimension, where dimensions are measured by their weakest contributor. Of course, other aggregations are possible as well (e.g., *ii* or "mini-min", *xi* or "maxi-min"). The many different combinations of aggregation rules (f_1 and f_2 functions) possible allow us to conduct sensitivity tests for the index.[5] These sensitivity checks are discussed in Section 5.

The preferred constructions (*aa*, *ag*), reported in Section 4, highlight three attributes of the OSS index: robustness, ease of interpretation, and comprehensiveness. The robust index (*ag*) is an arithmetic mean of geometric means. Using the *S* (short country span) variables further enhances its robustness, while sacrificing some sample coverage. The more easily interpreted index (*aa*) is an arithmetic mean of arithmetic means, which is also the most comprehensive if the *L (long country span)* variable set is used. The index construction described here applies to both the activity (*A*) and the potential (*P*) indices.

Weighted average indices.

The *aa* and *ag* aggregations give equal weights to the three dimensions (government, business, and community). Of course, the weight can be readily adjusted to suit other index users' preferences or purposes. Although an equal weighting followed from our extensive review of the literature in conjunction with input from various industry sources, a weighted average is worth pursuing to check for sensitivity. Unfortunately, any weighting scheme risks the appearance of arbitrariness. To mitigate this, we introduce an endogenous weighting approach where the weights are based on existing relations in the data. In this approach, all proposed variables are classified as either *directly* related to OSS (e.g., Firefox downloads, government OSS policies, number of Red Hat Certified Engineers) or *indirect*, contextual

4 Just as the indicator aggregations (f_2) were sensitive to missing values, so are the index aggregations (f_1) of dimensions. The indicator aggregation rules described here allow the dimension value to be computed even if one or more indicator values are missing. The index aggregation rules used here, however, do not. If a country is missing a value for one or more of its dimensions, an index value is not computed for that country.

5For each of three dimensions (government, firms, community), we consider five different aggregation rules for f_2, two different sets of indicators depending on data coverage (L or S), and two different sets of indicators based on type (B or R). This generates, essentially, some 60 different possible sub-indices for A and 60 more for P, which are subjected to a sensitivity analysis. The results reported here are among the least sensitive to these choices and the extent of this sensitivity is reported in discussion section.

variables (e.g., GDP, employment by sector, civil liberty index). For the *A* index, dimension (*G*, *F*, *C*) values are then computed using the best direct measures of *A* available and an arithmetic mean (or minimum) aggregation f_2. Next, each dimension value is regressed on the many indirect variables associated with *A*.[6] The fitted values from each dimension's regression are then aggregated as a weighted average (f_1), where the weights are the R^2 values from the regressions. Thus, the index value is a weighted average score across the different dimensions. The weights depend on how well the variables directly measuring OSS are explained by the indirect measures. The country's dimension values depend on its contextual values.

Using fitted values to compose the dimension values has the dual advantages of enabling greater coverage (a country that has a missing value for the direct variable can still have a predicted value) and of purging the dimension values of larger residuals or anomalous values in direct measures. Allowing the weights to derive from the auxiliary regressions replaces an arbitrary weighting imposed by the researchers with one that directly reflects to the extent to which variation in the direct OSS measure is explained by the data at hand. Dimensions that are better explained or predicted are thus given greater weight. On the other hand, this model reduces the ability of the analyst to apply expert knowledge or to experiment with their own weighting preferences. This procedure can be performed with direct variables that have more (*S*) or fewer (*L*) missing observations. All of this is done separately for activity and for potential variables and is denoted with *wa* for weighted average. There are 26 indicators[7] used to construct A_{wa} and 27 indicators[8] for P_{wa}. Table A1 in the Appendix also contains their definitions.

Finally, the *Ratio* index is derived directly from a pair of *A* and *P* indices' ranks. As such, it reflects the variations in constructions of *A* and *P*. It must be emphasized, however, that the *Ratio* index is a distinct index that measures something different than either activity or potential. Scaling a country's OSS activity by its OSS potential allows users to readily see which countries are "overachieving" and which are "underachieving" relative to their potential. In gross terms, this suggests where OSS growth potential is greatest. Decomposing

6 To construct the weighted averages, direct measures in each of the three dimensions are regressed on the set of indirect variables – making for three equations simultaneously estimated using least squares. A seemingly unrelated regression (SUR) framework is employed thereby allowing the error terms in each equation to be correlated, which seems plausible a priori because a country's unobservable OSS aspects may be correlated across dimensions. The SUR approach proves unnecessary with this data, as the independence of the equations cannot be rejected and separate regressions can suffice.

7 These include: rOSShits, GDPpcPPP, PCpc, XPpGDPm, iServerspc, InternetHostspc, OSSpolNat, OSSpolMun, OSSpolNatRD, OSSpolMunRD, dOSSpolNat, dOSSpolMun, dOSSpolNatRD, dOSSpolMunRD, OSSpolNatadv, OSSpolNatman, OSSpolNatpre, OSSpolMunadv, OSSpolMunman, OSSpolMunpre, dOSSpolNatadv, dOSSpolNatman, dOSSpolNatpre, dOSSpolMunadv, dOSSpolMunman, and dOSSpolMunpre. Because the Index C construction uses a linear fit of these variables and individual coefficients are not of particular interest, linear rescaling is inconsequential and so the variables enter the regressions in their raw form.

8 These include: Age2529pc, Age2024pc, TVpc, urbanpc, Age1524pc, Literacy, HSenroll, HSvoc, newspc, InternetUserspc, Phonespc, Radiopc, Cellspc, PhoneUSA, PhoneLoc, Phonelinespc, Phonelinespworker, PhoneWaittime, Phonepc, nNetPrice, GDPpc, TradepGDP, ICTpExport, SciArticlespc, POiGov, POinternet, and nWTO. Because the Index C construction uses a linear fit of these variables and individual coefficients are not of particular interest, linear rescaling is inconsequential and so the variables enter the regressions in their raw form.

the index, perhaps by re-weighting the dimensions constituting *A* and *P*, can suggest explanations for why some countries are over- or under-performing in OSS.

Results

Descriptive Statistics for the Indices

With so many possible indices to construct given the available data, only some of them can be described here for the sake of brevity. Table 2 reports descriptive statistics for four versions of the activity index ($A_{aa,BL}$, $A_{aa,BS}$, $A_{ag,RS}$, and A_{wa}), four corresponding potential indices ($P_{aa,BL}$, $P_{aa,BS}$, $P_{ag,RS}$, and P_{wa}), and two ratios ($Ratio_{ag,RS}$, $Ratio_{aa,BL}$). While Table 2 offers little in the way of intuition due to the varying scales across the indices, a few things should be evident at first glance. First and foremost, the number of countries (N) for which the index is available varies greatly across indices, as expected. Second, the variance in the index value differs widely across indices, suggesting that some index constructions involve more tightly clustered values than others. Given that the index values themselves have little cardinal meaning, we confine our interest to ordinal or rank values. Finally, not visible in Table 2 is that the weights across dimensions in A_{wa} and P_{wa} are not generally wildly different.[9]

Table 2: Descriptive Statistics for Select Indices

Variable	Obs (N)	Mean	Std. Dev.	Min	Max
$A_{ag,RS}$	47	0.69	0.66	0.00	2.02
$P_{ag,RS}$	105	7.29	6.07	0.98	44.23
$A_{aa,BS}$	47	0.36	0.52	-0.87	1.60
$P_{aa,BS}$	60	0.26	0.44	-0.73	1.27
$A_{aa,BL}$	132	0.11	0.58	-0.59	1.78
$P_{aa,BL}$	138	-0.01	0.60	-1.05	1.52
A_{wa}	121	0.00	0.51	-0.68	1.66
P_{wa}	74	0.02	0.56	-0.88	1.46
$Ratio_{agRS}$	42	0.09	0.10	0.00	0.43
$Ratio_{aa,BL}$	107	1.59	9.82	-9.78	81.30

Table 3 shows select pairwise rank correlations among the indices reported in Table 2. Each cell reports the Spearman correlation (and the number of observations used to compute it) between two corresponding indices. In other words, only correlations between activity indices or between potential indices are shown. The correlations reported in Table 3 are all statistically significant, positive, and in many cases generally quite large. The alternative index designs do appear to be measuring roughly the same thing. While some concern about the robustness of the activity measures is warranted due to the lower pairwise correlations

[9] For example, the weights for the *G*, *F*, and *C* dimensions in A_{wa} are 0.979, 0.896, and 0.818, respectively. The corresponding weights for P_{wa} are 0.833, 0.839, and 0.951.

with $A_{ag,RS}$, this result arises largely because of the particular ratio-scale variables used in the $A_{ag,RS}$ index.[10] Aside from the weaker relationship between the *R* and *B* variable sets for the activity index, the correlations range between 0.70 and 0.95 and are all significant at the 1% level. For the arithmetic mean indices, the long and short versions are correlated at 0.73 and 0.93 for the activity and the potential indices, respectively. This suggests that the cost, in terms of variable quality, for switching to variables that have a greater coverage of countries is relatively small, especially for the potential index. The rank orderings are also similar between the arithmetic mean and the weighted average versions. Whether it is 40 or 100 countries, the simple arithmetic mean generates a rank ordering that is highly correlated with the weighted-average approach. Table 3 suggests that the cost, in terms of less intuition and perhaps less valid proxy variables, for using the geometric means of ratio-scale variables to enhance robustness may be more substantial, however. Correlations in the first two columns of Table 3 are weaker, as would be expected given its nonlinearity and the restricted set of indicators.

Table 3: Rank-correlations, selected indices

	geometric mean ($X_{ag,RS}$)		weighted mean (X_{wa})		arithmetic mean ($X_{aa,BL}$)	
X=	A	P	A	P	A	P
$X_{aa,BS}$	0.4245* 47	0.6966* 56	0.7056* 46	0.9362* 40	0.7314* 47	0.9312* 60
$X_{aa,BL}$	0.4926* 47	0.7676* 103	0.8958* 103	0.9524* 71		
X_{wa}	0.4606* 46	0.7716* 63				

Table 4 shows the countries with the 20 highest values in several representative indices. It should be emphasized that the pool of countries included differs across indices, which complicates direct comparisons between the columns in Table 4. The first two columns derive from the geometric mean versions $A_{ag,RS}$ and $P_{ag,RS}$ reported in Table 2. Thus, these rankings are based on the index design preferred for its robustness. The next two columns do likewise for the arithmetic mean versions $A_{aa,BL}$, and $P_{aa,BL}$. These rankings are based on the index design preferred for its ease of interpretation and comprehensiveness.

[10] As shown in Table 5 in section 5, the rank correlations between the A_{ag} and other versions of A are significant and greater than 0.5 when the other versions use the ratio-scale variables or when computing $A_{ag,RL}$ with the "long" set of ratio-scale variables.

Table 4: Top 20 Countries in $X_{ag,RS}$, $X_{aa,BL}$

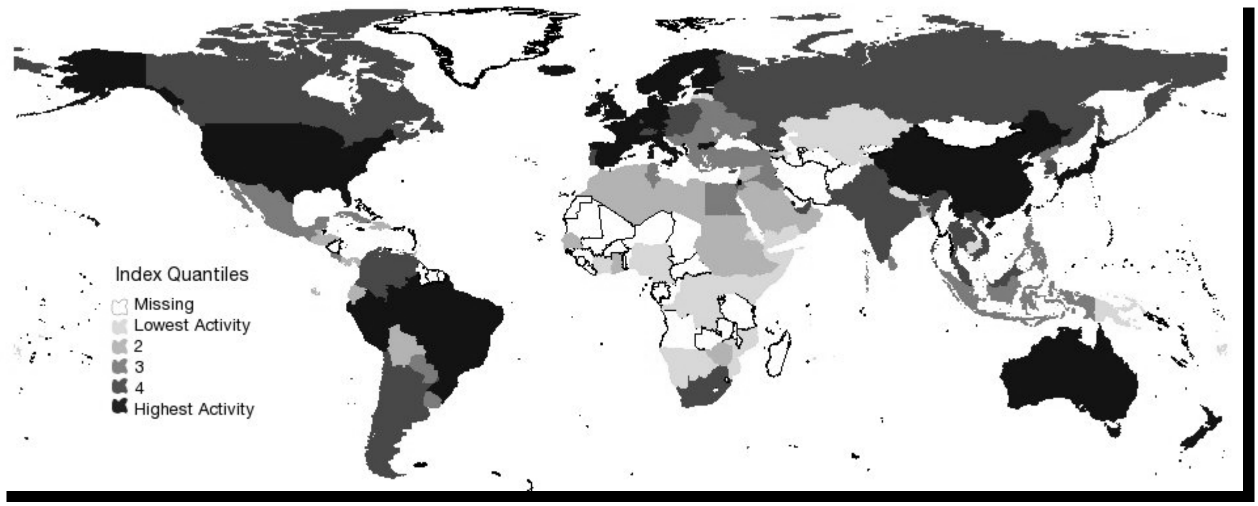
(rank) country			
$A_{ag,RS}$	$A_{aa,BL}$	$P_{ag,RS}$	$P_{aa,BL}$
1) Sweden	Spain	Iceland	Sweden
2) Ireland	France	Vanuatu	USA
3) France	Belgium	Latvia	Norway
4) United Kingdom	Iceland	Croatia	Denmark
5) Finland	Brazil	Czech	United Kingdom
6) Pakistan	Norway	South Korea	Canada
7) South Africa	United Kingdom	Lithuania	Netherlands
8) Paraguay	Qatar	Poland	Finland
9) Bulgaria	Denmark	Singapore	Switzerland
10) Vietnam	Finland	Slovenia	Australia
11) Israel	Taiwan	Panama	New Zealand
12) China	Peru	Cyprus	South Korea
13) Norway	Australia	Germany	Japan
14) Spain	Sweden	Hungary	Israel
15) Philippines	China	Estonia	Austria
16) Italy	Italy	Greece	France
17) Brazil	Netherlands	Ukraine	Germany
18) Venezuela	USA	Sweden	Belgium
19) Netherlands	Japan	USA	Iceland
20) Denmark	Estonia	Japan	Estonia

Maps

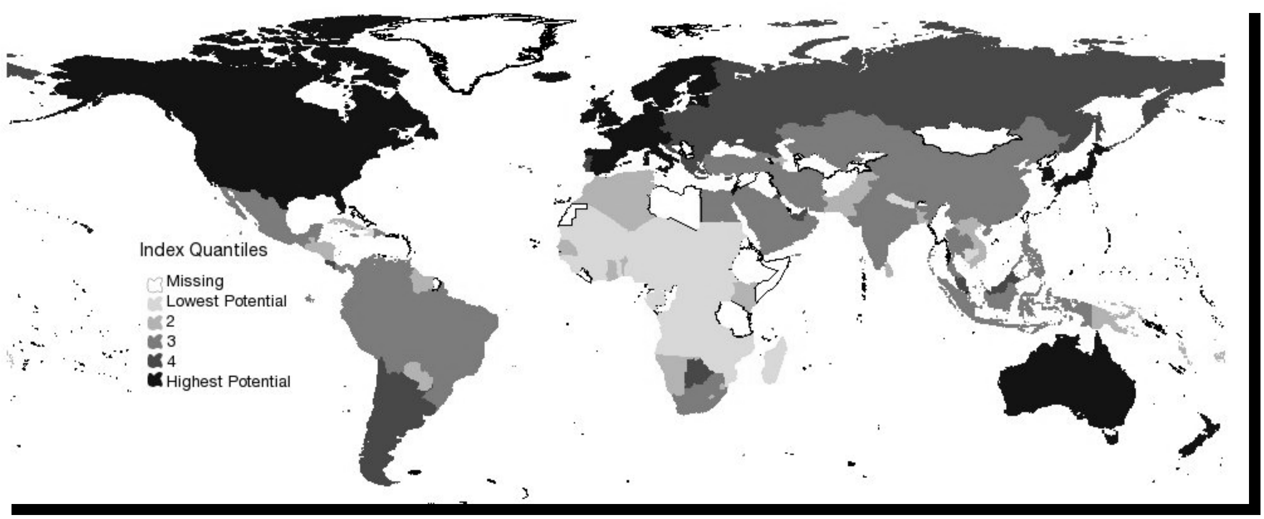
Figure 2 depicts maps of three different index values across the panels. Panel A and Panel B show the most comprehensive indices $A_{aa,BL}$ and $P_{aa,BL}$, respectively, while Panel C shows $Ratio_{wa,BL}$ (ratio of Activity to Potential). Higher index values are shaded darker, while countries with missing data are not colored in the world map. The maps indicate some broad patterns. Africa and the Middle East (and, to a lesser extent, eastern Europe, central America, and southeast Asia) lag behind in the OSS activity. South America shows a mix of activity, while South Africa stands out as the leading African nation. Solid performances are visible in high-profile OSS countries such as Brazil and Peru in South America and China, Japan, and Taiwan in Asia. The potential index maps shows a different pattern, one more broadly reflective of economic development and prosperity indicators. The ratio index map can be viewed, then, as depicting the extent of OSS activity relative to their background level of development or potential. Here, the OSS success of some high-profile countries (e.g., Brazil, Spain) stands out along with the success of some less noticed countries (e.g., Uzbekistan, Bulgaria). The regional patterns evident in Panel A are less distinct in Panel C, representing how the ratio index captures more than just regional patterns in economic development. Each continent appears to have considerable variation: some countries with high ratios (e.g., U.S., Spain, Oman, Ecuador, Egypt) and some with low ratios (e.g., Mexico, Switzerland, Peru).

Figure 2: Maps of select index quantiles (5)

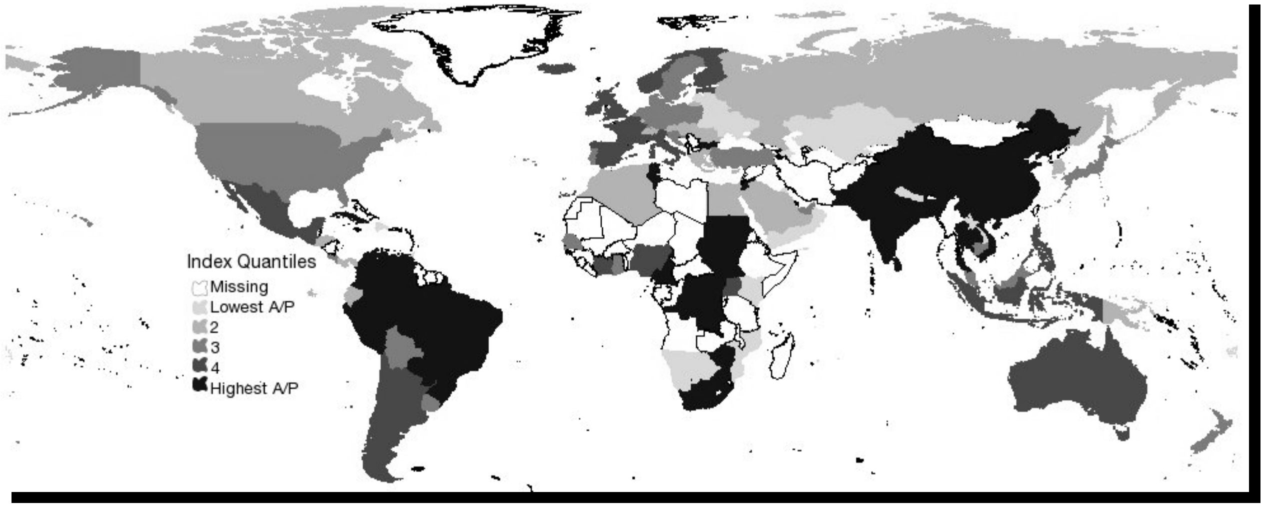
Activity Index Map ($A_{aa,BL}$)



Potential Index Map ($P_{aa,BL}$)



Ratio A/P ($Ratio_{wa,BL}$) Index Map



Sensitivity Analysis

With many candidate indices (and sub-indices), tests for robustness to different aggregation rules, sample sizes, and measure types are critical. The primary concern here is with correlations in rank-orderings (rather than raw values) derived from each index. Ideally, the OSS indices that measured similar things would not vary dramatically across different aggregation rules or types of measures. To the extent that the index is sensitive to these design choices, the usefulness of the index should be questioned.

Table 5 summarizes some of the observed Spearman rank-order correlations between alternative indices. Some variation is to be expected given that the different indices aim to measure different things (e.g., activity vs. potential vs. their ratio) and they employ different variables. Overall, a good deal of stability is found across aggregation rules. For the activity indices, all rank correlations are positive and nearly all are significant at the 5% level (usually at the 0.1% level). Rank correlations across different aggregation rules (while using the same indicators) are quite strong. Across 101 countries, the *A* ranks are significantly correlated between the arithmetic mean aggregation and the geometric mean (0.75), the maxi-min (0.69), and the mini-mean (0.64). Rank orderings do vary if the *A* depends on averages of indicators or on the "weakest link" of those indicators, but the rankings are still closely correlated. For similar index constructions, the correlations are even stronger. Indices with the same aggregation rules but different indicators (e.g., $A_{aa,BL}$ and $A_{aa,BS}$), are highly correlated; significant Spearman correlation coefficients exceed 0.5 in all but one case. For example, the rank correlation between long and short indices is 0.73 when using the best indicators and a simple arithmetic mean, and it is 0.90 when using ratio-scale variables and a geometric mean. Perhaps the strongest evidence that the *A* index is robust to aggregation rules (and even to alternate indicator variables) can be found in the high rank-correlation coefficient (0.82) between the preferred arithmetic mean and geometric mean indices for the "long" indicators ($A_{aa,BL}$, and $A_{ag,RL}$). Somewhat troubling is the weaker rank correlation for the corresponding "short" indicators. The short indices, which use better indicators but at the cost of a reduced sample, have weaker correlations across aggregation rules ($A_{aa,RS}$ and $A_{ag,RS}$ are correlated at 0.40). Similar results, often even stronger, hold even if the correlations reported in Table 5 are computed using casewise deletion (so that the same set of countries is used throughout). Moreover, as the lower half of Table 5 indicates, these general observations about the strength of correlations hold when looking at the potential indices (P).[11] Finally, Table 5 shows that the P indices are closely rank-correlated with P_{wa}. The indices are largely robust to alternative weights for averaging.

Table 5: Select index rank correlations

Activity									
	$A_{aa,BL}$	$A_{aa,BS}$	$A_{aa,RL}$	$A_{aa,RS}$	$A_{ag,RL}$	$A_{ag,RS}$	$A_{xi,BL}$	$A_{ia,BL}$	A_{wa}
$A_{aa,BL}$	1								
	132								
$A_{aa,BS}$	0.7314*	1							
	47	47							
$A_{aa,RL}$	0.7238*	0.7544*	1						
	101	47	101						
$A_{aa,RS}$	0.5611*	0.8414*	0.8897*	1					
	29	29	29	29					
$A_{ag,RL}$	0.8189*	0.4272*	0.6380*	0.3862*	1				
	101	47	101	29	101				
$A_{ag,RS}$	0.4926*	0.4245*	0.4185*	0.3961*	0.8957*	1			
	47	47	47	29	47	47			
$A_{xi,BL}$	0.8757*	0.7100*	0.6977*	0.3488	0.6991*	0.1962	1		
	132	47	101	29	101	47	132		
$A_{xi,BS}$	0.6074*	0.8111*	0.5649*	0.6471*	0.2364	0.2008	0.8106*		
	47	47	47	29	47	47	47		
$A_{xi,RL}$	0.8366*	0.4301*	0.6965*	0.3433	0.8833*	0.8447*	0.7429*		
	101	47	101	29	101	47	101		
$A_{xi,RS}$	0.5907*	0.5668*	0.4712*	0.3839*	0.7740*	0.9483*	0.3205		
	29	29	29	29	29	29	29		
$A_{ia,BL}$	0.8411*	0.5932*	0.6455*	0.6312*	0.6674*	0.4017*	0.7103*	1	
	132	47	101	29	101	47	132	132	
$A_{ia,BS}$	0.4556*	0.6619*	0.6244*	0.5966*	0.4372*	0.4307*	0.5663*	0.7553*	
	47	47	47	29	47	47	47	47	
$A_{ia,RL}$	0.7381*	0.7922*	0.6032*	0.4655*	0.5742*	0.0916	0.7667*	0.7595*	

[11] In many cases, the correlations are even stronger (e.g., $P_{aa,BL}$ has a greater rank-correlation with $P_{aa,BS}$ and $P_{ag,RL}$) but remain generally consistent with the activity variables. One exception is with the $P_{ia,RL}$ index, which is generally negatively correlated with other index measures. This surprising result largely follows from a negative correlation between the F dimension in the ratio-scale and the C dimension with the best variables for this subset of countries. This peculiar result poses only a minor concern because the odd-behaving ratio-scale version of P with a mini-mean aggregation is useful primarily for comparison to $P_{ag,RL}$, especially given that the superior $P_{ia,BL}$ index is present.

	101	47	101	29	101	47	101	101	
$A_{ia,RS}$	0.4409*	0.7138*	0.3222	0.4655*	0.0128	0.1621	0.6112*	0.5264*	
	29	29	29	29	29	29	29	29	
A_{wa}	0.8958*	0.7056*	0.6459*	0.5448*	0.7843*	0.4606*	0.8058*	0.7319*	1
	103	46	89	29	89	46	103	103	121
A_{wi}	0.8578*	0.8310*	0.6856*	0.6970*	0.7698*	0.4674*	0.8013*	0.7215*	0.9605*
	103	46	89	29	89	46	103	103	121
Potential									
	$P_{aa,BL}$	$P_{aa,BS}$	$P_{aa,RL}$	$P_{aa,RS}$	$P_{ag,RL}$	$P_{ag,RS}$	$P_{xi,BL}$	$P_{ia,BL}$	P_{wa}
$P_{aa,BL}$	1								
	138								
$P_{aa,BS}$	0.9312*	1							
	60	60							
$P_{aa,RL}$	0.7751*	0.8024*	1						
	77	51	77						
$P_{aa,RS}$	0.9316*	0.8857*	0.7820*	1					
	56	51	56	56					
$P_{ag,RL}$	0.9063*	0.8984*	0.7099*	0.8949*	1				
	111	56	77	56	128				
$P_{ag,RS}$	0.7676*	0.6966*	0.6391*	0.7047*	0.7549*	1			
	103	56	76	56	105	105			
$P_{xi,BL}$	0.8963*	0.8785*	0.8070*	0.9183*	0.8030*	0.7404*	1		
	138	60	77	56	111	103	140		
$P_{xi,BS}$	0.3913*	0.4903*	0.2588	0.2867	0.3580*	0.3805*	0.3669*		
	37	35	32	32	34	34	37		
$P_{xi,RL}$	0.5429*	0.7602*	0.6048*	0.8658*	0.5918*	0.3357*	0.4947*		
	108	56	70	52	92	88	108		
$P_{xi,RS}$	0.1884	0.2958	0.1151	0.0894	0.1664	0.3971*	0.2347		
	37	35	32	32	34	34	37		
$P_{ia,BL}$	0.9490*	0.9440*	0.7307*	0.9012*	0.8923*	0.7459*	0.8676*	1	
	138	60	77	56	111	103	138	138	
$P_{ia,BS}$	0.8442*	0.9042*	0.6943*	0.8144*	0.7682*	0.6460*	0.7928*	0.8575*	
	60	60	51	51	56	56	60	60	
$P_{ia,RL}$	-0.4131*	-0.4488*	-0.1247	-0.3436*	-0.4384*	-0.0764	-0.3619*	-0.3731*	
	77	51	77	56	77	76	77	77	
$P_{ia,RS}$	0.6742*	0.5959*	0.6123*	0.6798*	0.7290*	0.4700*	0.6703*	0.6632*	
	56	51	56	56	56	56	56	56	
P_{wa}	0.9524*	0.9362*	0.7106*	0.9127*	0.9256*	0.7716*	0.8352*	0.9264*	1
	71	40	49	38	63	63	71	71	74
P_{wi}	0.7607*	0.8906*	0.7327*	0.8602*	0.7355*	0.6733*	0.8016*	0.7801*	0.7348*
	71	40	49	38	63	63	71	71	74

* indicates significant at the 5% level.
Top number indicates Spearman rank correlation coefficient; bottom number indicates number of observations.
Shaded cells indicate correlations between indices with similar f_1 and f_2 aggregations. Dark-outlined cells indicate correlations between indices with similar variable sets.

Because the open source index is composed of three different sub-indices or dimensions, the robustness of the dimensions to alternative approaches also merits some scrutiny. As in Table 5, Table 6 shows the rank correlations between various constructions of the government (*G*), firms (*F*), and community (*C*) dimensions of the OSS indices. The dimension values are highly rank-correlated with one another even when produced with different aggregations or variable sets. This is especially true for the dimensions in the activity index, where the pairwise rank correlations between dimensions that use different aggregation rules or different variable lists are typically well over 0.7 and often over 0.95. The *G* and *F* dimensions for the potential index exhibit somewhat less consistency, where the $P_{\cdot i,BS}$ and $P_{\cdot g,RS}$ dimensions are weakly or uncorrelated with other aggregations using similar indicators. Although this presents some reason for caution, it bears emphasis that Table 6 shows rank correlations for 48 different dimension measures, and a few weak correlations are to be expected.

Table 6: Select Dimension Rank Correlations

Activity	Government							
	$A_{\cdot a,BL}$	$A_{\cdot i,BL}$	$A_{\cdot x,BL}$	$A_{\cdot g,RL}$	$A_{\cdot a,BS}$	$A_{\cdot i,BS}$	$A_{\cdot x,BS}$	$A_{\cdot g,RS}$
$A_{\cdot a,BL}$	1 193							
$A_{\cdot i,BL}$	0.8915* 193	1 193						
$A_{\cdot x,BL}$	0.9989* 193	0.8832* 193	1 193					
$A_{\cdot g,RL}$	0.9071* 122	0.9856* 122	0.9021* 122	1 122				
$A_{\cdot a,BS}$	0.4440* 48	0.5336* 48	0.4456* 48	0.6752* 48	1 48			
$A_{\cdot i,BS}$	0.5367* 48	0.6463* 48	0.4926* 48	0.7587* 48	0.7757* 48	1 48		
$A_{\cdot x,BS}$	0.2755 48	0.3549* 48	0.3093* 48	0.5139* 48	0.9421* 48	0.5627* 48	1 48	
$A_{\cdot g,RS}$	0.6680* 48	0.7719* 48	0.6745* 48	0.8620* 48	0.7738* 48	0.6933* 48	0.6470* 48	1 48
	Industry							
	$A_{\cdot a,BL}$	$A_{\cdot i,BL}$	$A_{\cdot x,BL}$	$A_{\cdot g,RL}$	$A_{\cdot a,BS}$	$A_{\cdot i,BS}$	$A_{\cdot x,BS}$	$A_{\cdot g,RS}$
$A_{\cdot a,BL}$	1 132							
$A_{\cdot i,BL}$	0.9142* 132	1 132						

$A_{\cdot x,BL}$	0.9900* 132	0.8712* 132	1 132					
$A_{\cdot g,RL}$	0.9756* 132	0.9651* 132	0.9547* 132	1 132				
$A_{\cdot a,BS}$	1.0000* 132	0.9142* 132	0.9900* 132	0.9756* 132	1 132			
$A_{\cdot i,BS}$	0.9142* 132	1.0000* 132	0.8712* 132	0.9651* 132	0.9142* 132	1 132		
$A_{\cdot x,BS}$	0.9900* 132	0.8712* 132	1.0000* 132	0.9547* 132	0.9900* 132	0.8712* 132	1 132	
$A_{\cdot g,RS}$	0.9756* 132	0.9651* 132	0.9547* 132	1.0000* 132	0.9756* 132	0.9651* 132	0.9547* 132	1 132
	Community, education							
	$A_{\cdot a,BL}$	$A_{\cdot i,BL}$	$A_{\cdot x,BL}$	$A_{\cdot g,RL}$	$A_{\cdot a,BS}$	$A_{\cdot i,BS}$	$A_{\cdot x,BS}$	$A_{\cdot g,RS}$
$A_{\cdot a,BL}$	1 190							
$A_{\cdot i,BL}$	0.9607* 190	1 190						
$A_{\cdot x,BL}$	0.8402* 190	0.7385* 190	1 190					
$A_{\cdot g,RL}$	0.3268* 190	0.3307* 190	0.2987* 190	1 190				
$A_{\cdot a,BS}$	0.9472* 190	0.9048* 190	0.8291* 190	0.2870* 190	1 190			
$A_{\cdot i,BS}$	0.8874* 190	0.9085* 190	0.7152* 190	0.2589* 190	0.9517* 190	1 190		
$A_{\cdot x,BS}$	0.8378* 190	0.7387* 190	0.9627* 190	0.2916* 190	0.8380* 190	0.7181* 190	1 190	
$A_{\cdot g,RS}$	0.3323* 190	0.3410* 190	0.3067* 190	0.9978* 190	0.2905* 190	0.2653* 190	0.2998* 190	1 190
Potential	Government							
	$P_{\cdot a,BL}$	$P_{\cdot i,BL}$	$P_{\cdot x,BL}$	$P_{\cdot g,RL}$	$P_{\cdot a,BS}$	$P_{\cdot i,BS}$	$P_{\cdot x,BS}$	$P_{\cdot g,RS}$
$P_{\cdot a,BL}$	1 179							
$P_{\cdot i,BL}$	0.7388*	1						

	179	193						
$P_{\cdot x,BL}$	0.8361* 179	0.3456* 179	1 179					
$P_{\cdot g,RL}$	0.8229* 130	0.6995* 130	0.6678* 130	1 130				
$P_{\cdot a,BS}$	0.5849* 94	0.6032* 95	0.3033* 94	0.5204* 78	1 95			
$P_{\cdot i,BS}$	-0.1135 47	0.2312 48	-0.1724 47	-0.1043 43	0.7047* 43	1 48		
$P_{\cdot x,BS}$	0.6136* 94	0.4162* 95	0.4428* 94	0.6029* 78	0.5572* 95	-0.129 43	1 95	
$P_{\cdot g,RS}$	0.8229* 130	0.6995* 130	0.6678* 130	1.0000* 130	0.5204* 78	-0.1043 43	0.6029* 78	1 130
	Industry							
	$P_{\cdot a,BL}$	$P_{\cdot i,BL}$	$P_{\cdot x,BL}$	$P_{\cdot g,RL}$	$P_{\cdot a,BS}$	$P_{\cdot i,BS}$	$P_{\cdot x,BS}$	$P_{\cdot g,RS}$
$P_{\cdot a,BL}$	1 140							
$P_{\cdot i,BL}$	0.6903* 140	1 140						
$P_{\cdot x,BL}$	0.9314* 140	0.5026* 140	1 140					
$P_{\cdot g,RL}$	0.5995* 140	0.3892* 140	0.5655* 140	1 185				
$P_{\cdot a,BS}$	0.6605* 75	0.3933* 75	0.5784* 75	0.5630* 75	1 75			
$P_{\cdot i,BS}$	0.4235* 75	0.4661* 75	0.3194* 75	0.5047* 75	0.6986* 75	1 75		
$P_{\cdot x,BS}$	0.6016* 75	0.1541 75	0.6613* 75	0.4253* 75	0.7962* 75	0.3199* 75	1 75	
$P_{\cdot g,RS}$	0.3601* 126	0.4873* 126	0.2473* 126	0.2921* 133	0.2870* 75	0.3078* 75	0.1418 75	1 133
	Community, education							
	$P_{\cdot a,BL}$	$P_{\cdot i,BL}$	$P_{\cdot x,BL}$	$P_{\cdot g,RL}$	$P_{\cdot a,BS}$	$P_{\cdot i,BS}$	$P_{\cdot x,BS}$	$P_{\cdot g,RS}$
$P_{\cdot a,BL}$	1 175							
$P_{\cdot i,BL}$	0.9584*	1						

	175	175						
$P_{\cdot x,BL}$	0.9783* 175	0.9025* 175	1 175					
$P_{\cdot g,RL}$	0.9246* 175	0.8845* 175	0.8984* 175	1 186				
$P_{\cdot a,BS}$	0.9466* 155	0.9032* 155	0.9218* 155	0.9217* 157	1 157			
$P_{\cdot i,BS}$	0.7705* 155	0.7905* 155	0.7107* 155	0.7332* 157	0.7954* 157	1 157		
$P_{\cdot x,BS}$	0.8864* 155	0.8166* 155	0.8930* 155	0.8574* 157	0.9570* 157	0.6481* 157	1 157	
$P_{\cdot g,RS}$	0.8951* 175	0.8559* 175	0.8669* 175	0.9727* 184	0.9323* 157	0.7250* 157	0.8863* 157	1 184

Conclusions and Future Directions

The *A* and *P* indices should be considered works in progress. Their purpose is first to spur discussion and further development of measures of this important aspect of the global IT industry. Second, the indices facilitate for others the exploration of potential impacts of open source software and approaches at a country level. An important next step—and test—for the index lies in its use by policy makers, industry, and others in crafting strategies and policies for the advancement of open source interests and ICT development more broadly.

Until now, much of the OSS domain is dominated by anecdotal and informal knowledge, especially about the state of OSS on a global scale. The *A* and *P* indices represent an important first step in advancing discussions about global OSS development by providing systematic and robust empirical evidence on a global scale. To do so, we confronted head-on the difficulties in constructing useful indices for such a tricky concept as OSS activity or potential. Our efforts attempt to reflect the openness and transparency of the OSS enterprise, thus our methods are described in detail here and the base data are readily available for download by the broader "user community" for this research. While we believe that the indices presented here provide a good "snapshot" of a country's open source potential and activity, it is worth noting that better data collection—beyond the scope of the current project—could improve the index in subsequent iterations. We welcome continued improvements to and adaptations of these indices.

Turning to policy considerations, government commissions and agencies have proposed, and in some cases implemented, a variety of measures to encourage open source developers. For example, in the United States, the President's Information Technology Advisory Committee (2000) recommended direct federal subsidies for open source projects to advance high-end computing, and a report from the European Commission (2001) also discussed support for open developers and standards. Many European governments have policies to encourage the use and purchase of open source software for government use. As is well known, governments can sponsor the development of localized open source projects. Economists have sought to understand the consequences of a vibrant open source sector for social welfare. Perhaps not surprisingly, definitive or sweeping answers have been difficult to come by. But if a tentative conclusion can be made, most analyses have concluded, based on limited data, that government support for open source projects is likely to have an ambiguous effect on social welfare.

We hope that these indices are not the end product of research in this area, but rather the beginning of an empirical research agenda at the intersection of OSS and public policy. Future research could make use of these indices to test a variety of hypotheses about the causes and effects of OSS and related policies. Anecdotal evidence, case studies, and intuitions pervade the OSS discourse. Thus far, much of the literature has very limited generalizability because of the prevalence of case-study approaches. The OSS indices presented here can help bring light where there is much heat. For example, the frequent claims about OSS's liberating nature and positive implications for social welfare (made often by governments themselves) lack a strong empirical basis. Future research can use these OSS indices to systematically assess the societal impacts of effects of OSS. The indices can enable testing of hypotheses about whether OSS drives innovation, economic development, transparency in governance, or other social aims. These indices can also play pivotal roles in studies of the rise of OSS activity. Identifying the determinants of OSS activity, and the factors that influence which countries achieve more of their OSS potential, merits additional investigation.

If “footloose” developers can participate in OSS projects across boundaries, what role does the state and geography more generally have in guiding the evolution of OSS? The OSS indices can inform studies of the effectiveness of particular OSS policies and initiatives on developing OSS, of strategic interdependence between states in setting their OSS policy (akin to trade policy), of the influences of different political and cultural landscapes on the popularity of OSS, and of the impact of education programs on OSS. Knowing where the cathedrals and bazaars are will hopefully launch a new set of inquiries into the determinants of that distribution and the implications of greater OSS activity and potential.

Appendix A

Variable List

Variables in Index A and Index P	Indicator	Source
OSSpolNatman	Count of policies at the national level that mandate open source software	Center for Strategic and International Studies “Government Open Source Policies” 2008
GovExppGDP	Government expenditures as percent gross domestic product	World Development Indicators 2003
OSSpolNatRD	Count of policies at the national level that provide R&D for open source software	Center for Strategic and International Studies “Government Open Source Policies” 2008
OSSfundng	Ratio of national and local R&D policies to all national and local policies	derived from Center for Strategic and International Studies 2008
RHCEpc	number of Red Hat Certified Engineers	Red Hat, Inc. 2008
LinuxUserspc	Number of GNU/Linux users registered per capita	Linux Counter 2008
GoogleApppc	Number of applications submitted to Google Summer of Code per capita	Google Summer of Code 2005
SchoolNet	Percent schools connected to Internet	CIA World Fact Book 2004
rOSSnews	Number of hits for “open source software” on Google News archives within country during 2008	Google News 2008
LinuxLang	1 if native language support for GNU/Linux, 0 if otherwise	Distro Watch
nPiracy	Number of pirated software units divided by total number of units put into use, negative transform	Business Software Alliance 2006
OOXML	-1 if country voted for OOXML passage, 0 if No, empty if abstained or not invited	Open Malaysia Blog, ISO 2008
nCivLib	Freedom in the World Index of Civil Liberties scored 1 through 7, higher being worse, negative transform	Freedom House 2006
Turnout	Percent voters of voting age population (1945 to 1998)	International IDEA
eGov	e-Government Survey Score	United Nations 2008
nTRIPS	-1 if participant of TRIPS (Trade Related Aspects of Intellectual Property)	World Trade Organization 2008
nIPRI	Intellectual Property RIghts Index, higher score indicates more rights, negative transform	Property Rights Alliance 2008
ICTtop250pGDP	Number of ICT firms in the Top 250 per gross domestic product	OECD 2005
ICTexpendpGDP	ICT expenditures as percent gross domestic product	CIA World Fact Book 2004

newCellGro	Growth of number of cell phones from 1995 to 2001, percent growth over baseline year	World Development Indicators 2001
TelecomInvestpc	Private investment in telecoms (current US$) per capita	International Telecommunications Union 2001
SciArticlespc	Number of published scientific and technical journal articles per capita	World Development Indicators 1999
RnDemploypc	Scientists and engineers per capita	World Development Indicators 2000
nNetPrice	Price basket for Internet service per month, negative transform	CIA World Fact Book 2003
inewGrowth	Growth of Foreign Direct Investment from 2001 to 2006, percent growth over baseline year	United Nations Conference on Trade and Development
TVpc	Number of television sets per capita	World Development Indicators 2000
Techphob	Percent students who consider themselves technophobic	Computers in Human Behavior 1995
College	Percent of college aged population enrolled	World Development Indicators 2000
GradEngpgrad	Graduates in engineering, manufacturing and construction (% of total graduates, tertiary)	World Development Indicators 2000
PCspc	Number of personal computers per capita	International Telecommunications Union 2004
InternetUserspc	Number of Internet users per capita	International Telecommunications Union 2004
Awa Variables		
rOSShits	Hits for "open source software" on Google by region=country	Google 2008
GDPpcPPP	Gross domestic product per capita adjusted purchasing power parity	2002
PCpc	Personal computers per capita	International Telecommunications Union 2004
XPpGDPPm	Cost of Windows XP in "gross domestic product months"	First Monday – Ghosh
iServerspc	Internet servers per capita	CIA World Fact Book 2005
InternetHostspc	Computers connected to Internet per capita	Computers in Human Behavior 2007
OSSpolNat and (d) OSSpolMun and (d) OSSpolNatRD and (d) OSSpolMunRD and (d) OSSpolNatadv and (d) OSSpolNatman and (d) OSSpolNatpre and (d) OSSpolMunadv and (d) OSSpolMunman and (d) OSSpolMunpre and (d)	Two variables were created as a count of all National and Municipal level policies. These variables were further subdivided to create counts of policies that indicated just Mandates, Preferences, Advisorys, or R&D. This resulted in 10 variables. For each count variable, a dummy variable was created indicating 0 if no policy, 1 if one or more. Therefore, 20 policy variables total were available.	Center for Strategic and International Studies "Government Open Source Policies" 2008
Pwa Variables		
Age2529%	Persons age 25 to 29 as percent population	CIA World Fact Book 2005

Age2024%	Persons age 20 to 24 as percent population	CIA World Fact Book 2005
Age1524%	Persons age 15 to 24 as percent population	CIA World Fact Book 2005
TVpc	Television sets per capita	World Development Indicators 2001
urban%	Percent population residing in urban area	2002
Literacy%	Percent population 15 and older who are literate	
HSenroll%	Percent eligible population enrolled in high school	World Development Indicators 2002
HSvoc	Enrollment in upper secondary technical/vocational programs	OECD 2005
newspc	Number of daily newspapers per capita	2000
InternetUserspc	Number of Internet users per capita	International Telecommunications Union 2004
Phonespc	Telephone landlines per capita	World Development Indicators 2001
Radiopc	Radio sets per capita	World Development Indicators 2001
Cellspc	Cellular phones per capita	World Development Indicators 2001
PhoneUSA	Average cost of telephone call to US (US$ per three minutes)	World Development Indicators 2001
PhoneLoc	Telephone average cost of local call (US$ per three minutes)	World Development Indicators 2001
Phonelinespc	Telephone mainlines in largest city (per 1,000 people)	World Development Indicators 2001
Phonelinespworker	Telephone mainlines per employee	World Development Indicators 2001
PhoneWaittime	Telephone mainlines, waiting time (years)	World Development Indicators 2000
Phonepc	Fixed line and mobile phone subscribers (per 1,000 people)	World Development Indicators 2001
nNetPrice	Price basket for Internet service per month, negative transform	CIA World Fact Book 2003
GDPpc	Gross domestic product per capita	World Development Indicators 2003
TradepGDP	Trade as percent of gross domestic product	World Development Indicators 2003
ICTpExport	Communications, computer, etc. (% of service exports, BoP)	World Development Indicators 2002
SciArticlespc	Number of scientific or technical journal articles published per capita	World Development Indicators 1999
POiGov	PO offers electronic services, percent of 12 potential services	Original data collection
POInternet	Post Office provides public Internet access points (1=yes, 0=no)… year=2005 or most recent if missing	Original data collection
nWTO	-1 if member of World Trade Organization	World Trade Organization 2007

Appendix B

Complete Index Values

Table A2: Select index ranks for all countries

Country	$A_{aa,BL}$	$A_{aa,BS}$	$A_{ag,RL}$	$A_{ag,RS}$	$P_{aa,BL}$	$P_{aa,BS}$	$P_{ag,RL}$	$P_{ag,RS}$	$Ratio_{aa,BL}$	$Ratio_{ag,RL}$	$Ratio_{aa,BS}$	$Ratio_{ag,RS}$	A_{wa}	P_{wa}
Afghanistan	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Albania	.	.	.	.	41	.	9	54	.	.	.	.	93	6
Algeria	99	.	92	.	86	.	97	94	38	81	.	.	88	.
Andorra	.	.	.	.	.	.	14	.	.	.	.	.	.	.
Angola	.	.	.	.	132	.	.	.	.	.	.	.	99	65
Antigua and Barbuda	.	.	.	.	.	.	4	.	.	.	.	.	.	.
Argentina	39	42	36	32	49	.	7	21	8	40	.	29	32	30
Armenia	101	.	.	.	.	.	.	.	.	.	.	.	98	.
Australia	13	10	22	25	10	13	15	29	36	23	13	22	12	9
Austria	34	16	51	37	15	14	21	43	65	48	18	33	29	13
Azerbaijan	129	.	47	.	99	.	.	.	21	.	.	.	.	45
Bahamas	62	.	33	.	.	.	17	.	.	33	.	.	.	.
Bahrain	58	.	60	.	.	.	.	.	.	.	.	.	58	.
Bangladesh	84	.	87	.	105	58	114	85	64	77	.	.	110	70
Barbados	88	.	.	.	.	.	48	.	.	.	.	.	52	.
Belarus	72	.	84	.	28	.	.	.	87	.	.	.	.	15
Belgium	3	13	10	23	18	16	25	42	11	14	10	17	1	8
Belize	.	.	.	.	72	.	57	.	.	.	.	.	56	.
Benin	.	.	.	.	109	.	121	87	.	.	.	.	108	71
Bhutan	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bolivia	83	.	45	.	78	43	40	59	29	42	.	.	94	49
Bosnia and Herzegovina	66	.	.	.	.	.	.	.	.	.	.	.	.	.
Botswana	128	.	86	.	43	.	104	75	102	75	.	.	78	56
Brazil	5	32	4	17	55	46	68	45	2	1	30	15	10	.
Brunei Darussalam	65	.	.	.	.	.	.	.	.	.	.	.	.	.
Bulgaria	22	23	16	9	47	29	53	56	5	11	5	5	15	26
Burkina Faso	.	.	.	.	124	.	126	82	.	.	.	.	118	.
Burundi	.	.	.	.	129	.	.	.	.	.	.	.	.	72
Cambodia	123	.	.	.	127	.	102	.	48	.	.	.	75	.
Cameroon	107	.	48	.	126	.	113	80	66	43	.	.	101	64
Canada	33	24	53	39	6	8	13	27	76	52	22	35	24	.
Cape Verde	.	.	.	.	.	.	91	.	.	.	.	.	.	.
Central African Republic	.	.	.	.	138	.	.	.	.	.	.	.	.	.
Chad	.	.	.	.	136	.	.	.	.	.	.	.	.	.
Chile	28	.	40	.	48	33	62	50	6	35	.	.	20	28
China, People's Republic of	15	22	6	12	66	48	.	.	106	.	32	.	28	.
Columbia	36	.	.	.	60	27	83	63	103	.	.	.	25	33
Comoros	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Congo, Democratic Republic of the	105	.	101	.	130	60	.	.	72	.	.	.	.	.
Costa Rica	59	44	46	30	52	32	58	58	95	41	31	27	53	32
Croatia	53	26	58	42	46	.	55	4	85	51	.	40	61	23
Cuba	68	.	.	.	98	.	.	.	70	.	.	.	.	.
Cyprus	50	31	57	41	37	.	44	12	82	50	.	39	48	.
Czech Republic	47	.	56	.	40	25	60	5	73	46	.	.	41	.

Côte d'Ivoire (Ivory Coast)	108	.	99	.	115	.	.	.	62	.	.	.	100	.
Denmark	9	9	17	20	4	7	8	31	30	21	16	19	4	.
Djibouti	112	.	.	.	.	.	124	.	.	.	.	.	.	.
Dominica	.	.	.	.	.	.	81	.	.	.	.	.	49	.
Dominican Republic	97	.	79	.	73	.	36	74	15	73	.	.	.	.
Ecuador	80	.	.	.	65	54	86	70	10	.	.	.	87	51
Egypt	77	.	82	.	64	49	101	88	13	66	.	.	89	43
El Salvador	90	.	81	.	85	45	56	30	42	72	.	.	83	.
Equatorial Guinea	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eritrea	131	.	.	.	.	.	.	.	.	.	.	.	.	.
Estonia	20	.	30	.	20	.	26	15	27	28	.	.	42	11
Ethiopia	100	.	100	.	.	.	.	.	.	.	.	.	121	68
Fiji	118	.	70	.	101	.	90	47	28	59	.	.	70	.
Finland	10	2	18	5	8	6	18	24	26	20	4	9	5	4
France	2	7	1	3	16	12	23	34	14	2	7	6	17	.
Gabon	.	.	.	.	117	.	.	.	.	.	.	.	82	.
Gambia	111	.	.	.	112	.	119	99	61	.	.	.	.	69
Georgia	.	.	.	.	57	.	74	90	.	.	.	.	.	.
Germany	21	15	20	28	17	15	1	13	33	24	14	25	27	12
Ghana	93	.	.	.	94	.	118	84	53	.	.	.	72	52
Greece	61	.	65	.	38	37	46	16	86	60	.	.	59	25
Grenada	.	.	.	.	54	.	75	.	.	.	.	.	51	.
Guatemala	91	.	.	.	95	.	106	89	56	.	.	.	86	53
Guinea	.	.	.	.	133	.	.	.	.	.	.	.	.	.
Guinea-Bissau	.	.	.	.	135	.	.	.	.	.	.	.	.	.
Guyana	.	.	.	.	84	.	80	81	.	.	.	.	.	.
Haiti	103	.	98	.	137	.	115	102	78	85	.	.	.	.
Honduras	104	.	.	.	96	52	99	86	46	.	.	.	95	61
Hong Kong	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hungary	45	.	34	.	29	23	41	14	67	30	.	.	50	19
Iceland	4	1	35	31	19	.	22	1	12	36	.	31	3	.
India	29	29	27	24	79	59	96	71	98	4	27	11	35	60
Indonesia	70	41	85	46	81	44	84	78	50	71	1	41	90	.
Iran, Islamic Republic of	.	.	.	.	62	57	77	83	.	.	.	.	31	38
Iraq	71	.	.	.	.	.	.	.	.	.	.	.	.	.
Ireland	23	5	19	2	21	19	31	37	37	16	2	3	13	.
Israel	38	14	9	11	14	.	28	22	75	12	.	14	30	17
Italy	16	17	13	16	26	18	27	44	19	15	12	13	16	10
Jamaica	.	.	.	.	75	35	73	68	.	.	.	.	77	.
Japan	19	.	.	.	13	4	20	20	43	.	.	.	22	3
Jordan	60	.	66	.	77	42	92	46	74	54	.	.	84	42
Kazakhstan	125	.	80	.	67	.	34	36	4	74	.	.	.	.
Kenya	117	.	44	.	104	50	.	.	34	.	.	.	107	63
Kiribati	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kuwait	81	.	69	.	51	.	45	67	101	61	.	.	62	.
Kyrgyzstan	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Laos (Lao People's Democratic Repub..	132	.	.	.	100	.	.	.	22	.	.	.	111	.
Latvia	114	.	68	.	27	.	33	3	93	63	.	.	54	16
Lebanon	85	.	74	.	.	.	61	.	.	68	.	.	76	.
Lesotho	.	.	.	.	89	.	94	64	.	.	.	.	.	55
Liberia	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Libya (Libyan Arab Jamahiriya)	89	.	.	.	.	.	.	.	.	.	.	.	.	.

Liechtenstein	.	.	.	.	.	.	3	.	.	.	.	.	.	.
Lithuania	76	.	29	.	35	.	43	7	90	26	.	.	46	29
Luxembourg	44	.	55	.	25	.	35	.	77	49	.	.	21	.
Macedonia, Former Yugoslav Republic..	64	.	.	.	.	.	.	.	.	.	.	.	.	35
Madagascar	.	.	.	.	119	.	105	98	.	.	.	.	114	.
Malawi	.	.	.	.	116	.	.	.	.	.	.	.	120	.
Malaysia	43	37	23	26	39	21	49	26	40	13	24	23	67	20
Maldives	74	.	67	.	.	.	89	.	.	55	.	.	.	.
Mali	.	.	.	.	114	.	128	.	.	.	.	.	116	.
Malta	49	.	38	.	.	.	37	.	.	38	.	.	45	.
Marshall Islands	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mauritania	.	.	.	.	118	.	.	.	.	.	.	.	106	.
Mauritius	116	.	64	.	53	.	59	60	105	57	.	.	64	31
Mexico	54	.	42	.	56	38	67	51	100	34	.	.	63	36
Micronesia, Federated States of	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Moldova	127	.	83	.	33	.	.	.	97	.	.	.	105	34
Monaco	37	.	.	.	.	.	.	.	.	.	.	.	.	.
Mongolia	.	.	.	.	.	.	70	41	.	.	.	.	104	46
Montenegro	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Morocco	102	.	93	.	93	55	100	79	45	82	.	.	92	44
Mozambique	124	.	.	.	113	.	.	.	41	.	.	.	.	.
Myanmar	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Namibia	120	.	78	.	92	.	93	95	20	67	.	.	81	.
Nauru	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nepal	119	.	75	.	110	.	111	96	39	62	.	.	117	.
Netherlands	17	8	11	19	7	11	10	33	47	19	11	18	11	.
New Zealand	25	.	32	.	11	20	16	32	60	32	.	.	19	.
Nicaragua	.	.	.	.	103	.	98	.	.	.	.	.	.	.
Niger	.	.	.	.	134	.	127	105	.	.	.	.	119	73
Nigeria	115	.	.	.	120	.	109	91	54	.	.	.	112	.
North Korea (Korea, Democratic Peop..	79	.	.	.	.	.	.	.	.	.	.	.	.	.
Norway	6	4	15	13	3	5	6	28	25	22	8	16	2	2
Oman	92	.	72	.	68	.	.	.	9	.	.	.	.	.
Pakistan	42	25	12	6	106	.	78	76	91	3	.	1	36	59
Palau	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Panama	86	.	73	.	71	39	82	11	16	65	.	.	66	48
Papua New Guinea	113	.	95	.	107	.	110	100	57	80	.	.	96	.
Paraguay	55	34	26	8	87	.	88	61	81	5	.	2	33	47
Peru	12	45	43	34	69	41	71	65	107	39	34	30	7	.
Philippines	69	46	25	15	76	40	79	73	32	8	33	4	40	.
Poland	40	21	54	40	30	24	42	8	44	47	6	37	44	22
Portugal	35	27	61	44	32	28	39	49	35	56	19	38	34	21
Qatar	8	.	.	.	.	.	.	.	.	.	.	.	.	.
Romania	63	.	63	.	45	26	47	23	89	58	.	.	71	.
Russian Federation	48	.	31	.	34	30	52	48	80	27	.	.	79	24
Rwanda	.	.	.	.	131	.	.	.	.	.	.	.	.	.
Saint Kitts and Nevis	.	.	.	.	.	.	72	.	.	.	.	.	.	.
Saint Lucia	.	.	.	.	.	.	51	.	.	.	.	.	.	.
Saint Vincent and the Grenadines	.	.	.	.	.	.	85	.	.	.	.	.	.	.
Samoa	121	.	.	.	.	.	.	.	.	.	.	.	68	.
San Marino	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sao Tome and Principe	.	.	.	.	.	.	63	.	.	.	.	.	.	.

Saudi Arabia	82	.	.	.	70	.	.	.	18	.	.	.	74	50
Senegal	95	.	90	.	97	.	117	52	52	78	.	.	102	62
Serbia	75	.	.	.	.	.	.	.	.	.	.	.	.	.
Seychelles	.	.	.	.	36	.	64	.	.	.	.	.	.	.
Sierra Leone	.	.	.	.	123	.	125	104	.	.	.	.	.	.
Singapore	24	18	52	38	24	.	2	9	31	53	.	36	23	.
Slovakia	51	30	59	43	31	.	.	.	83	.	.	.	43	18
Slovenia	30	12	49	35	23	.	30	10	55	44	.	34	38	.
Solomon Islands	.	.	.	.	.	.	116	77	.	.	.	.	.	.
Somolia	109	.	.	.	.	.	.	.	.	.	.	.	.	.
South Africa	32	28	7	7	61	56	.	.	104	.	28	.	37	40
South Korea (Korea, Republic of)	31	36	14	21	12	1	19	6	69	18	23	24	39	5
Spain	1	19	3	14	22	17	29	40	7	6	15	12	6	14
Sri Lanka	73	40	41	33	91	.	95	62	59	31	.	28	57	.
Sudan	94	.	88	.	122	.	122	103	71	76	.	.	.	74
Suriname	.	.	.	.	88	.	54	.	.	.	.	.	.	.
Swaziland	.	.	.	.	108	.	.	.	.	.	.	.	.	.
Sweden	14	3	5	1	1	2	5	18	51	17	17	8	8	1
Switzerland	27	20	50	36	9	10	24	38	63	45	20	32	26	7
Syria	96	.	91	.	.	.	.	.	.	.	.	.	91	.
Taiwan (Republic of China)	11	.	.	.	.	.	.	.	.	.	.	.	.	.
Tajikistan	130	47	94	47	.	.	.	.	.	.	.	.	.	.
Tanzania	126	.	.	.	.	.	.	.	.	.	.	.	73	.
Thailand	46	43	24	27	74	47	76	57	96	9	3	20	55	39
Timor-Leste	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Togo	.	.	.	.	125	.	107	97	.	.	.	.	113	67
Tonga	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trinidad and Tobago	87	.	71	.	59	34	38	25	3	64	.	.	65	41
Tunisia	56	.	37	.	90	53	87	66	79	29	.	.	85	54
Turkey	67	.	77	.	63	36	69	39	17	69	.	.	80	.
Turkmenistan	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tuvalu	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Uganda	122	.	96	.	128	.	112	53	49	83	.	.	115	66
Ukraine	78	39	76	45	42	22	66	17	94	70	29	42	60	.
United Arab Emirates	52	.	62	.	44	.	.	.	84	.	.	.	.	.
United Kingdom (of England, Scotlan..	7	6	2	4	5	9	12	35	24	7	9	7	9	.
United States of America	18	11	28	22	2	3	11	19	58	25	21	21	14	.
Uruguay	57	38	39	29	50	31	50	69	88	37	26	26	69	27
Uzbekistan	106	.	.	.	58	.	32	72	1	.	.	.	.	.
Vanuatu	.	.	.	.	83	.	108	2	.	.	.	.	.	.
Vatican City	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Venezuela	26	35	21	18	82	51	65	55	99	10	25	10	18	37
Vietnam	41	33	8	10	102	.	.	.	92	.	.	.	47	.
Yemen	110	.	97	.	80	.	120	93	23	84	.	.	103	57
Zambia	.	.	.	.	111	.	123	101	.	.	.	.	109	58
Zimbabwe	98	.	89	.	121	.	103	92	68	79	.	.	97	.

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Collective Ownership in Free/Libre and Open Source Software: The OpenSolaris Case

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Abstract

The aim of this paper is to investigate the practices supporting collective ownership in a corporate-sponsored Free/Libre and Open Source Software (FLOSS) project. The paper focuses on the idea that property is shaped by the practices of participants in a FLOSS project. Property is not considered in its legal status, but as a form of collective ownership, which controls and directs the project's future. Drawing on ethnographic research, collective ownership emerges as the result of practices involving both the corporate environment and FLOSS developers. In effect, the practices of the collective redefine themselves as the legitimate practices of that collective

Keywords: practices, collective ownership, property, free/libre and open source software, corporation

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Collective Ownership in Free/Libre and Open Source Software: The OpenSolaris Case

Free/Libre and Open Source Software (FLOSS) can be seen as an indicator of deep transformations in the modes of production, in both organizational and social terms. This has come about because FLOSS has been an example for social arenas other than software development projects, such as the construction of collective content (e.g. Wikipedia) or the creation of new relationships with the Intellectual Property laws (e.g. Creative Commons). In this study, I consider FLOSS as a way of developing software that is protected by a copyright license which grants developers access to the source code and the right to modify and distribute it.

Some scholars have pointed out how software licenses can be considered to be moving from a regime of exclusion to a regime of distribution, and have indicated that this change has transformed some forms of organization towards a more democratic production process, reducing the presence of hierarchy in the producers' everyday lives (Shirky, 2008). They have characterised such a change (towards a regime of distribution) as a new form of production based on peers working together, and have considered this to be a major societal change (Tapscott & Williams, 2006). In contrast, some of the literature on FLOSS has pointed out that FLOSS projects can be much more “closed door” than expected, challenging the assumption of a democratizing process and a societal change in production processes (Krishnamurthy, 2002). The current debate is therefore increasingly in need of a focus on the processes that allow the inclusion of new participants in FLOSS projects, and the ability of such new participants to affect those projects’ futures. In brief, we need to understand the construction of boundaries in and around FLOSS projects, and boundary-work is exactly the kind of work that defines legitimate and illegitimate participants (D'Andrea, De Paoli, & Teli, 2009; De Paoli, Teli, & D'Andrea, 2008). The task at hand is part of the phenomenology of boundary-work in FLOSS projects. This is particularly important because Intellectual Property is, according to the sociologist Scott Lash (2002), the means by which the accumulation of capital currently takes place. Comparing it to real property, Lash points out that when speaking about real property, "rights" deal with the exploitation of workers in a power relationship, whereas "rights in intellectual property rights are rights to *exclude* others from valorizing the objects [...]" and "in intellectual property, it is the property itself that can create the surplus value” (2002: 195-196). Researching property and ownership in the digital arena is, therefore, a way of contributing to the understanding of value creation and power relationships in contemporary society, with a possibility of connecting this understanding to domains other than FLOSS. Although that is outside the actual scope of this paper, it belongs to the framework supporting it.

This paper refers to that research on property and ownership in terms of understanding which practices and processes create boundaries to participation in FLOSS projects. Moreover, this paper starts from one of the key arenas of FLOSS activity, property – in order to show how the practices involved in managing something owned collectively are the same practices contributing to such boundary-work, and that these practices take place within a collective whose characteristics foster the enlargement of future objectives as well as encouraging future participants in the same practices. To achieve this aim, this paper is organized as follows:

(i) an introduction to the issue of property (including Intellectual Property) in FLOSS, reviewing how scholars have linked property to deep organizational transformations; such a review may lead to the adoption of a practice-based approach which considers

(a) property and software to be part of a developer's practices, and

(b) ownership to be an activity that creates the collective;

(ii) the description of the OpenSolaris case, its history and its most relevant contribution to the understanding of the problem of collective ownership;

(iii) concluding discussions and remarks showing how the collective construction of FLOSS practices includes the elements of a possible permanent critique of the status quo.

Intellectual Property and FLOSS

In the context of studying inclusion and exclusion in contemporary society, FLOSS is quite a useful empirical field, especially in relation to property rights and power. In fact, since its origin, FLOSS practitioners have rearticulated some fundamental concepts of copyright: the issue of intellectual property – and changes in it – has been crucial in FLOSS participants' practices since the 1980s. Indeed, the relationship between FLOSS, property, and software as goods, has been investigated widely by scholars, and we can find at least three different kinds of approach that try to explain changes in the intellectual property regime concerning FLOSS. The three approaches are: the ontological approach to software as informational goods, the consequentialist approach, and the approach of the practical construction of property.

In these approaches, the majority of scholars share the political scientist Steven Weber's idea (2004) of a movement from a property regime based on exclusion towards a property regime based on distribution. Focusing on collective ownership, this paper questions this movement, arguing that exclusion is a still a key factor in the current regime of property, and that even when the legal regime changes, as with FLOSS, there is still a kind of boundary-work at stake, therefore exclusion and distribution should be considered in relation to control over any object that is property. However, exclusion and distribution in relation to what? The concept of property, to be empirically useful, requires the presence of goods, something that is the object of ownership. In this case, the object involved is software, which has been conceptualized as a particular kind of commons, a "knowledge commons" (Hess & Ostrom, 2007), and the characteristics of such an object are the focus of the ontological approach to software.

Ontologies of Software as Informational Goods

Putting forward the hypothesis that software is a "knowledge commons" means, first of all, that it is a resource shared or shareable among different actors, due to its intrinsic characteristics of being not subject to subtractability and exclusion at the same time (Hess &

Ostrom, 2007). Denying the characteristic of subtractability to a collection of goods means, mainly, to draw upon its characteristic of immateriality, which makes it possible that one individual acquiring a piece of goods doesn't exclude someone else from acquiring the same piece of goods – as it does with material goods. Alternatively, while underlining the impossibility of exclusion, the focus is on making a piece of goods public: when an object is public, nobody can benefit from it in an exclusive way. These two characteristics make the "knowledge commons" different from commons made of natural shared resources (e.g. pastures) that always, according to Hess and Ostrom (2007), need to be managed by a collection of principles, the most interesting of which being that individuals participate in the modification of the rules, while working according to those same rules for control over the goods (*ibidem*: 7). In such a context, FLOSS is an innovation, and a model for the new "knowledge commons" – for the "cornucopia of the commons" (Bollier, 2007; Schweik, 2007), in contrast with the "tragedy of the commons" (Hardin, 1968). The particular innovation is the absence of natural boundaries, as well as the construction of boundaries that are artificial (Ostrom & Hess, 2007). The contribution from these kinds of study starts from the point of view of commons being resources, but what if we look at them as the objects of a production process?

Yochai Benkler (2007) proposed a similar analysis, considering software as a piece of public goods, the object of a production process. He has underlined how information (and software is considered to be a form of information) has two main characteristics: it is a non-rival piece of goods and it is an object that is both a resource used in, and a result of, the production process. By "non-rival" he refers to the same concept Ostrom and Hess (2007) have identified as "non-subtractability", shifting the focus towards the process of consumption of the goods: when someone accesses a piece of information, doing so does not exclude someone else from accessing the same information. Considering informational goods as both inputs and outputs of the production process, Benkler emphasizes that information gets produced from the starting point of other information, so the costs someone has to face while acquiring information in the production phase have consequences for the amount of information that can be produced and, moreover, the costs of acquisition give shape to the population of potential producers, selecting who may access the production process. Benkler, Ostrom and Hess use the same conceptualization of goods: an ontological one.

By "ontology of goods", I refer to a conceptualization of a piece of goods as having some characteristics "in itself", independently from the social practices that surround it. From such characteristics, a "right" way of relating to the object can be derived, a way that maximizes the possibility of duration in time (if the goods are considered as resources) or quantitative production (if the goods are considered to be the objects – or results – of a production process). Nevertheless, such an approach is unable to give us the tools for understanding the construction of the artificial boundaries around the piece of goods, or to help us describe how the process of building rules around the object takes place.

A slightly different view is the one that starts with production, in particular from the quality of production in terms of innovation, and that makes it possible to evaluate the consequences of property on the development process. Such an approach is the topic of the next section.

Consequences of Changes in Property

According to Shah and Tripsas (2007), end-user innovation, another of the labels used to describe phenomena like FLOSS, is different from the "classic model of the entrepreneurial process" (129), because users are closer to their needs and therefore have a competitive advantage in terms of access to information when compared to companies, considered as institutionalized innovators. End-user innovation has been interpreted as a form of democratization of innovation, because it makes it possible for a wider group of people to participate in the construction of new technologies (von Hippel, 2004). Here, historical examples are connected to a local definition of the costs of innovation, and this definition considers them lower than the costs of acquiring a solution from the market (Nuvolari, 2005) or waiting until the market develops new solutions (Shah, 2005). Moreover, FLOSS is considered to be an example of community-based innovation, as it is an innovation coming from groups of users who share information about the changes they have made to the products they are using. Innovation communities arise only when two conditions are satisfied: "open product design" and "open communication". In particular, "open product design" means that users are able to modify – "tinker with" – the product or service (Shah, 2005). This is possible, as Shah pointed out, when the intellectual property regulations, the institutional and the technological arrangements, allow open product design. The presence or absence of open product design is, therefore, a consequence of the intellectual property regime, and the open intellectual property regime has two consequences: "(a) user innovation will only flourish in open source, and (b) users inclined to innovate will gravitate towards open source." (*ibidem*). Moreover, community-based innovation seems to be more effective and efficient than institutionalized innovation, so according to this approach, it is possible to argue that efficiency and efficacy are a consequence of the relationship with property that has been established in a certain context. The particular property regime will therefore support "peer production", which can be seen as emerging as "an alternative model of production that can harness human skills, ingenuity and intelligence more efficiently and effectively than traditional firms" (Tapscott & Williams, 2006: p. 66). In relation to informational goods, such success in efficiency and efficacy makes it possible to bypass manufacturers, who are no longer required (von Hippel, 2005). Focusing on FLOSS, this leaves three remaining possibilities for manufacturers: to provide specific services to specific users; to sell supporting tools or to sell complementary goods (*ibidem*). Therefore, the changes in the intellectual property regime entail a societal change that goes deeper into the structure of production, almost envisioning new roles for manufacturers, who might be considered as unnecessary, at least to the process of producing informational goods. Not only is the role of manufacturers changing, but it is becoming necessary that governmental policies on the regulation of intellectual property change. Indeed, with this approach, we enter a virtuous circle that involves FLOSS and other end-user innovations, the intellectual property regime, and innovation again. In one respect FLOSS is the empirical proof of the viability, efficiency, and efficacy of end-user innovation processes. The intellectual property regime should therefore promote these kinds of innovation processes, which will, in the end, increase the efficiency and efficacy of the innovation process in the same way. Nevertheless, the change in the property regime is endogenous to development and innovation practices, while forms of co-ordination and organization of work are the consequences of changes in the regime itself. In conclusion, both the ontological and consequentialist approaches share a view of property regulation as detached from the practices of FLOSS: the first starts from the inherent characteristics of the goods, while the second starts from the empirical proof of a more innovative model of production. The next section will deal with the approach of considering software as a social practice, and will rearticulate that both software and its consequences are the result of more finely grained software developers' activities.

Software as a Social Practice

Using a different approach from those previously cited, Christopher Kelty (2008) has analyzed the birth of the "EMACS commune" and of the GNU (GNU is Not Unix) General Public License, showing how the legal system of defining copyright has been reworked and reappropriated in FLOSS practices in relation to specific and particular contexts. For example, the creation of the "EMACS commune" emerged as the practical solution to the presence of bugs in the source code of the EMACS text editor, and as a way of making possible its extension, by adding new functions, while the GNU GPL emerged as the solution to the contingent intellectual property problems that the GNU project was facing. As an American anthropologist pointed out, the GNU GPL arose from a controversy, and it was considered a "hack" of the copyright system. Hack, in this context, refers to "work-arounds; clever, shortest-path solutions that take advantage of characteristics of the system that may or may not have been obvious to the people who designed it." (*ibidem*: 182). Property in the GNU GPL, in its legal sense, therefore emerged as a practical solution to ownership problems rooted in development practices. There was no ontological element to the software, and technology was constructed using the same practices instead of being a pre-existing element, as in the ontological approach, or a desired outcome of external processes, as in the consequentialist approach.

Looking at entities as being co-constructed during the process of their production means to look at them not as discrete objects, but as things produced in such a way that they were the "cultural production of new forms of practice" (Suchman, Blomberg, Orr, & Trigg, 1999: 404). From this point of view, considering software and property as social practices means to understand them as producing new forms of practice. But what is a practice? In the field of Organization Studies, Silvia Gherardi defined a practice as a way of doing things that is "relatively stable in time and socially recognized, for ordering heterogeneous items into a coherent set"(Gherardi, 2005: 34). Such a definition of "practice" is useful for facing the issues at stake here, because it underlines how practices are the locus where ownership is constantly being redefined by doing and in relation to other items while, at the same time, creating ownership does not happen in a vacuum, but emerges from a relatively stable and recognized set of elements. In this sense, a hack, like the one of writing the GNU GPL, can be legitimately conceived of as a practice, because it orders heterogeneous items (property and code, together) into a coherent set. At the same time, the social recognition of it as a practice shares the same definition of "hack" as recognized by hackers, and is an almost stable way of facing problems.

Looking at practices in this way, and at Free Software from such a practice-based perspective, leads us directly to considering ontologies not as fixed elements, as in the ontological approach cited earlier, but as emergent in practices. The ontological status of software as a commons or a piece of public goods is therefore a consequence of practically-based processes. As Annemarie Mol pointed out, questioning the ontological status of a thing is almost the same as questioning the different potential performance of an object, trying to answer the questions, “Which one is performed? Under which conditions?” (Mol, 1999). The different ontologies emerge in different political relationships and carry with them different political relationships. In such a perspective, looking at the initial focus of this paper– the construction of boundaries to participation in a FLOSS project – property can be seen as an ontology under construction, and politics in FLOSS as politics in relation to this ontology.

Property and Ownership in FLOSS

In relation to the ownership of software, looking at the construction of property as an ontology created by practices means, above all, understanding property – in its application to software – as a resource and an object of the production process at the same time. If we look at "property", we can find at least two different nuances in the meaning of the word. The first one can be synthesized by the same word “property”, and could be strictly construed in the legal sense of the word, as “the exclusive right to possess, enjoy, or dispose of a thing” (Merriam-Webster, property[1]), while in a wider sense it can be interpreted as “ownership”, that is “to have power or mastery over a thing” (Merriam-Webster, to own[2]). The changes in the copyright regime concerning FLOSS have been recognized both in legal literature and in the literature focusing on organizational, productive, and cultural dynamics (cf Tuomi, 2001; Vaidhyanathan, 2001). Both these bodies of literature stress how property and ownership have changed towards a more collective orientation. Take the example of the Linux kernel: nobody legally owns the entire kernel, but the GNU GPL v2 is ensuring that participants can develop a way of managing the future of the kernel as a collective. Mastery of and power over the kernel are distributed, although not equally.

Moreover, the blurring of the boundaries that protect access to source code has been seen as a way of bringing developers and users closer, so that the boundary between them – between the ones who refer to software as a "resource" and the ones who refer to it as an "object of production" – is dismantled by the law (cf. Rosen, 2005). Although the boundary is legally absent, in practical terms the boundary has not blurred homogeneously, so that one person will go on considering software as a resource while someone else will participate in the production process, for example with access to the Concurrent Versioning System (De Paoli & D'Andrea, 2008). The process of being allowed to participate in the production process is not easy or linear, as shown by Coleman and Hill (2004), but it is, for the developer, at the same time a process of enculturation in a project. Asking a question like “who owns software?” (Klang, 2005) is therefore a question of the empirical phenomenology of ownership practices, and as such it becomes a fundamental question when seeking to understand contemporary society, and also to understand the contribution of FLOSS to contemporary politics in the form of rebalancing societal relationships. This kind of ownership is legally and institutionally supported primarily as a form of property by software

[1]http://www.merriam-webster.com/dictionary/property [03/27/2010]
[2]http://www.merriam-webster.com/dictionary/owner [03/27/2010]

licenses, as mentioned in the GNU GPL preamble:

> "The licenses for most software and other practical works are designed to take away your freedom to share and change the works. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change all versions of a program--to make sure it remains free software for all its users." (GNU GPL 3 Preamble)

The statement made by Free Software Foundation is clear: the GNU GPL was born as a form of legal support to the practices of sharing and modification as a form of software ownership. Ontological and consequentialist approaches have almost limited themselves to describing this change as a way of transforming the mode of production, in a causal nexus between the legal dimension and the organizational one. Such conceptualizations have been connected to radical changes, as in the already cited forms of democratization of the production and innovation processes (von Hippel, 2005). At the same time, other researchers have underlined how FLOSS development does not democratize in a homogeneous way, but that it is possible, empirically, to find forms of development that remain closed to a wider participation (Krishnamurthy, 2002).

Ownership as power and mastery therefore remains as a possible practice, but only for some individuals, in some contexts. Indeed, the issue at stake, to answer Klang's question, is the construction of boundaries to participation in FLOSS production, and the description of specific and empirically discovered boundaries that will better rearticulate the exercise of this power of exclusion in terms of software production. In this sense, answering this fundamental question means answering two deeply sociological questions: who and what is included in, or excluded from, such a group? How does the group take shape?

Collective Dynamics in FLOSS Projects

Some scholars in different fields have already tried to answer these questions, for example O'Mahony and Ferraro (2007). Discussing "how social collectives govern, organize, and co-ordinate the actions of individuals to achieve collective outcomes" (1079), they argued in favor of an analysis of the construction of governance and the characteristics of leaders. In their analysis of the Debian project, what emerged clearly was the role of crisis, in particular a crisis of authority, in defining the characteristics of leaders, who had to be more and more able to align "both organisation-building and technical activities to the project's vision and goals" (1091). This happens in a group of people that "sets a formal bureaucratic basis of authority to reinforce its meritocratic norms. However, this approach depends upon democratic mechanisms that not only limit that basis of authority, but also allow the system to adapt with members' changing interpretations of leadership" (1079-1080). While the contribution of these authors is extremely valuable in understanding the processes internal to a project, it is not able to show how the same processes construct boundaries to participation in the same project – only that the project is flexible enough to adjust to changes.

A similar limitation, in relation to the question posed by this paper, affects the study by

Gabriella Coleman and Mako Hill (2004). Their work is also related to the Debian project, and their question is related to “the rise and cultivation” (*ibidem*: 275) of ethics in the project itself. The ethical commitment of developers is therefore a result of their participation in the project and not just based on an initial, clearly defined set of values. As they write, “participation in FLOSS projects like Debian contributes to the solidification of a pre-existent ethical commitment to information freedom” (*ibidem*: 278). In their contribution, the practical construction of ethics is inscribed in procedure and artifacts, as is their case study, the Debian New Maintainer Process, and it is rooted in a context in which “institutional independence, volunteer labor, and networks of trust can act as key elements in facilitating moral development within occupational groups” (275). Coleman and Hill's work certainly helps in understanding how the practices of FLOSS and their artifacts construct the discourse on ethics and legitimate behavior but, at the same time, does not investigate how some practices and discourses are excluded by a FLOSS project.

Both these papers (O'Mahony and Ferraro's, and Coleman and Hill's) stressed the inherent technosocial perspective of FLOSS developers and projects, as also strongly emphasized by Christopher Kelty (2008). His analysis of co-ordination in the Linux and Apache projects, of the “meaningful technosocial practice of managing, decision-making, and accounting”, stresses how the key is “*adaptability* over *planning*” (*ibidem*: 211). Adaptability is, in this account, an incremental process of implementing changes, and it is stronger in its effects when it relies upon crisis or controversial issues. Adaptability becomes particularly political because it configures itself as an infrastructure and as “the province of critique” (*ibidem*: 222), when it provides “the ability to critique existing designs and to propose alternatives without restrictions” (*ibidem*: 235). Putting together the three contributions analyzed here, the picture that emerges is of FLOSS projects as involved in co-ordinating themselves through a technosocial perspective, that includes both the infrastructure for co-ordination and adaptability and the social processes connected to it, in terms of leadership, enculturation, and decision-making. Nevertheless, these accounts still consider what takes place *within* a FLOSS project, while almost completely dismissing how the same projects give shape to what remains *excluded* from the FLOSS dynamics.

In a series of papers written with colleagues, I have discussed exactly this kind of problem, the double-sided issue of boundary-work, as including and excluding at the same time (De Paoli, Teli & D'Andrea, 2008; D'Andrea, De Paoli & Teli, 2009). In these studies we have relied on actor-network theory accounts of group formation, in order to show how FLOSS artifacts and controversies “participate in the construction of both relational ecologies and political and technical boundaries” (De Paoli, Teli & D'Andrea, 2008). In this paper, I wish to further the study of specific artifacts, in order to grasp the relational ecologies that legitimate the participants in a FLOSS project, in other words those exercising collective ownership of the software. In conformity with the stance of considering that “the free/open character of FLOSS should not be assumed as an a priori explanation” (*ibidem*), I draw upon the same theoretical standpoint, the actor-network theory, in order to understand how ownership is not only the result of social practices but “also affording the construction and reproduction of these practices” (*ibidem*). In actor-network theory, one of the most comprehensive accounts of group dynamics and collective construction is Bruno Latour's “Politics of Nature” (Latour, 1999). According to this French author, collective construction and dynamics are built around four different kinds of practices: those that introduce perplexity about the actual composition of a collective, those that evaluate the pertinence of possible new participants, those that construct a hierarchy among the legitimate participants, and those that support the institutionalization of the collective constructed in this way, in some sense stabilizing it, at least temporarily. The goal of this paper is precisely to understand the practical construction of a collective form of ownership in a FLOSS project.

Corporate FLOSS: The Opensolaris[3] Case

As I have already mentioned, FLOSS has been studied a lot, and most of what has been said focuses on it as the organization of volunteers' work. Despite all this, Kelty (2008) has pointed out that FLOSS is a set of practices “neither corporate nor academic, neither profit nor nonprofit, neither governmental nor nongovernmental” (211). At the same time, little has been said on the FLOSS relationship with the corporate world, and in particular on the practices emerging when a for-profit organization decides to “open source” one of its pieces of software with a FLOSS license, although there are more and more cases like this, including Microsoft Inc., the standard-bearer, in FLOSS rhetoric, of the proprietary software companies.

A case of the “open sourcing” of code is particularly interesting for the aims of this paper, both for the relevance of the phenomenon and for the new questions that it presents. When a corporation decides to “open source” one of its software products, we can see the process of the construction of collective ownership in its ecological relationship with its previous proprietary status. Moreover, if something about FLOSS practices is inherently able to democratize the production process, these elements should also be found in the case of a previously hierarchical organization. Indeed, the elements of adaptability need to pursue the same goals as the previous practices and should be able to question them, moving issues like: “Who and what is included in or excluded from such a group? How does the group take shape?” towards an understanding of the elements that sustain the potential shift.

This happens in a social context that contrasts FLOSS with the concept of “proprietary software”, underlining how the difference between the two ways of creating software exists in their usage of the legal concept of property. While we can take for granted such legal differences, it tells us nothing about how the presence of a corporation shapes the practices of collective ownership. In this paper, therefore, I will focus on the specific case of such an encounter, the OpenSolaris case. The OpenSolaris project was launched after an initiative by Sun Microsystems, Inc. (from now on referred to as Sun[4]), the launch configuring itself as an action inside the software industry, with the necessity of being accountable to Sun's shareholders and investors. Starting from this point of view, after a brief historical introduction to Sun, Solaris and OpenSolaris, I will describe how the choice of “open sourcing” some of the software produced by Sun (above all, the famous Java technology) can be connected to a vision of the evolution of the software industry and of all of society that Jonathan Schwartz, Chief Executive Officer at Sun, described as a shift toward the

[3]Solaris, OpenSolaris, Java and Sun are registered trademarks owned by Sun Microsystems, Inc.
[4]Sun Microsystems has been recently acquired by Oracle Corporation. The data used in this work do not include this recent acquisition, on which I am planning future work.

“Participation Age”. This is connected to a vision of business opportunities based on the business model of “Radio Antennas”. The narrative on FLOSS as a strategic business choice has been constructed by two Sun engineers, Richard Gabriel and Ron Goldman, who dedicated a book to it: “Innovation happens elsewhere” (2005). This trajectory underlines the importance of aligning different social practices, those of the corporate world with those of FLOSS. These practices will be the focus of the next section. Before that, it is necessary to describe the research methodology.

A Cyberethnography of FLOSS

Cyberethnography, as opposed to ethnography without attributes, seeks to underline how ethnography is able to grasp the hybrid, fluid and unfinished character of the entities involved (Teli, Pisanu, & Hakken, 2007), as well as the fact that the boundaries of the community being studied are not fixed, but emerge from the act of observation, as remembered by Katie Ward: “Cyber-ethnography differs from regular ethnography as it avoids holding any preconceived ideas concerning the existence of community.” (1999: 96). This method is therefore the one best able to understand groups in their construction, focusing on the practices involved in that construction. Moreover, Cyberethnography is concerned with non-modern epistemologies (Latour, 1993), avoiding assumptions about the relevant elements, human or non-human, in the theoretical and methodological account.

The OpenSolaris project was followed ethnographically from June 2005 to March 2007, when the Constitution of the project was approved by a vote taken in the OpenSolaris Community. During that period, the data sources were the project mailing lists, the Internet Relay Chat channels, and the developers' blogs. In some cases, a few interviews by email were carried out, although the prevalent approach was one of passive observation. This is to be distinguished from archive research through the practice of observation, which was performed daily and almost in real time. (The observation, data archiving and taking of field-notes took between two and three hours a day throughout the whole period.) Observation was aided by the analysis of natural documents, both those produced by Sun, before and after the start of the project, and those produced by the participants themselves after the start, whether legal (Charter, Constitution, license) or technical (Developers' Reference, How-Tos, etc.) in nature. Data was then analyzed by means of grounded theory techniques (Dey, 2004; Glaser & Strauss, 1967) in order to grasp inductively the processes of collective construction taking place in the project. As stated before, the first questions arising when looking at collective construction are questions of perplexity and pertinence, and this story should start with an understanding of those elements from the corporate point of view, by trying to investigate under what conditions a corporation ended up considering FLOSS to be a legitimate choice. "Perplexity" means questioning the current composition of the collective and its current practices, so the first part of this story talks about the history of Sun, Solaris and OpenSolaris. In particular, what will be shown is how the practices and events in the software industry and in Sun's own history created perplexity among the corporate owners, which resulted in a movement towards FLOSS as a way of controlling software.

Sun, Solaris and Opensolaris

On 24 February 1982, four former students of computer science, Andy Bechtolsheim, Vinod Khosla, Scott McNealy and Bill Joy, joined forces to create Sun Microsystems. In a short period of time other programmers joined Sun, among them John Gage. John, who was Chief Researcher and Vice President of the Science Office during my fieldwork (he is now retired), is famous because he created, in the 1980s, the slogan “The Network is the Computer”, referring mainly to distributed computing as a way of processing information that involves several computers connected in a network, executing different parts of a program. Since then, the slogan has characterized Sun, and is still used today, framed as the “vision” of the company:

> “Since 1982, Sun has maintained that the network is the computer. Sun's vision is to see everyone and everything participating on the network. Sun's mission is to create technologies and fuel communities that enable sharing and participation. Sun's cause is to eliminate the digital divide. Eliminating the digital divide allows everyone to take part in opportunities and contribute to solutions regardless of their geographic location or economic situation.” (www.sun.com/aboutsun/company)

The technological narrative, “the network is the computer”, has become a social narrative that states as its own objective the enlargement of participation in sharing practices. Nevertheless, for a long period of time this vision and slogan were associated with the sale of proprietary software, as in the case of Solaris, the operating system developed by Sun. In June 2005, Solaris was released under the Common Development and Distribution License (CDDL), a FLOSS license, and the OpenSolaris project started. How did it happen that a for-profit corporation questioned its own practices, moving from a proprietary software model towards a FLOSS strategy? It was after the economic crisis of 2000, when the so-called “dot-com bubble” burst, that Sun management started questioning its own practices in relation to software development, as remembered by Simon Phipps, Chief Open Source Officer at Sun:

> “Sun had a sort of near-death experience, when the [dot-com] bubble burst. It saw its stock price go down to a tenth of its previous value, and it saw the need to dismiss large numbers of staff. It became suddenly very obvious that lots of the people who didn't share Sun's values didn't belong here anymore; it also became very obvious that some of the approaches to software that Sun had been taking weren't actually in keeping with Sun's long-term values.” (Moody, 2007).

On one hand, the critical situation can be seen to have caused some perplexity about practices that had already become consolidated, while on the other hand, the slogan “The Network is the Computer”, gave the incentive to align software development practices with company strategy. FLOSS, which is based on Internet collaboration, became a pertinent response to a critical situation. This alignment, in its turn, introduced perplexity into a different social arena and context, that of the investors and shareholders. The previously existing, stabilized practice of dealing with crises by means of management discourseprovided the tool to face this new source of perplexity: the business model.

FLOSS as a Business Model

I have already mentioned how changes to Sun’s software distribution model − with the option to release Solaris as OpenSolaris − necessitated Sun having to sell this strategy to investors and shareholders. Managers needed to show investors and shareholders that FLOSS was pertinent to Sun's business strategy. This was particularly important because although Sun was releasing software like OpenOffice.org and NetBeans with FLOSS licenses before Solaris/OpenSolaris, these were fringe markets for Sun, whose core business was selling hardware, particularly servers and the services to support them. By contrast, Solaris is a key component, being the operating system for those servers. Sun needed to show, therefore, that FLOSS was as pertinent as Solaris to its core business.

The notion of this connection between FLOSS and Sun's core business did not arise from a vacuum, but had been developed over quite a long period of time, both before and after the launch of OpenSolaris. In 2004 Sun's Chief Executive Officer, Jonathan Schwartz, described for the first time the societal changes that allowed the combination of Sun, a FLOSS-based strategy and the “The Network is the Computer” slogan, to appear in alignment with social processes. This is how he described the shift from the “Information Age”, the rhetoric supporting the dot-com bubble, to the “Participation Age”, defined as a societal phase:

> “… in which an open and competitive network fuels growing opportunities for everyone − not simply to draw data or shift work around the world, but to participate, to create value and independence. If the Information Age is passive, the Participation Age is active” (Schwartz, 2004).

This background forms the basis for subsequent problems, and for their solutions, and in it FLOSS has had a key role, allowing Sun to “lower the cost of computing, lower barriers to entry, […] fuel the communities that give rise to the next era of network computing” (*ibidem*). With such a societal shift, the issue remained one of creating economic value for shareholders and investors. Responding to this issue, Schwartz, during the Sun Analyst Summit (Schwartz, 2007), made explicit Sun's strategy, which was that by increasing value they could increase their market share: “Volume drives Value”. Using an analogy with the radio market, Schwartz compared Sun to the producers of radio antennas, who benefit from the growth of the radio audience. Reducing the barriers of entry to the use of information technology, with FLOSS being one of the main elements in achieving this, is therefore part of a business strategy aimed at increasing the number of users (volume). Attracting new people and enlarging the boundaries of potential participants led to the transformation of a business model and the development of operational guidelines on how to build a FLOSS project in a business environment. This is the subject of the next section.

FLOSS as the Enlargement of Participation

The opportunity and necessity of involving more participants external to the company was the starting point for the book “Innovation Happens Elsewhere” (2005) by two Sun engineers, Goldman and Gabriel . In it, they mention facing the problem of describing FLOSS as a business strategy, based on the notion that “business is changing after the expansive thinking of the late 1990s followed by the lessons learned in the early 2000s: It no longer makes sense for every company to make and own every aspect of its business” (p. 1).

Sun shipped this book free of charge to anybody who registered on the Sun Developer Network, making it a reasonable source from which to evaluate Sun's view of FLOSS as a business strategy. According to the two authors, and taking for granted the need to include others in the development of their technology, the main advantage for those who decide to include FLOSS in their strategy is an increase in innovation capacity, which engenders increased productivity. This resembles the consequentialist approach discussed earlier. Goldman and Gabriel not only indicate the potential positive outcomes of following this path, but also the elements that should be considered when doing so: “Engaging in an open-source project requires understanding the community, its culture and customs, its tools, and its way of working [...] the work involves community building, politics, citizenship, principles, and governance.” (*ibidem*: 7-9). This has consequences for the company's internal organization because, according to the two engineers, “An open-source project breaks down organizational boundaries both within your company and between your company and the outside world” (*ibidem*: 273).

This path involves giving away part of the control over software as property, and the construction of an almost independent governance structure, although the consequences of this shift and the changes resulting from the development of a collective form of ownership are at this point still not clear.

Governing the Future

The role of Sun was questioned extensively in relation to the structure of the Community and the decision-making process. This email extract gives another glance into the problems that arose:

“>[5] I asked the then-CAB-now-OGB to bias against new community proposals in favour of

> projects, so that new technical efforts start as projects.

This is IMO a good start to address barrier-to-entry, but it doesn't address my overall concerns I've tried to articulate above around who will own the strategy and roadmaps of which these technical efforts are necessarily a part.

Having projects which are not under the guidance of a community seems to indicate an unspoken presumption that the strategy and roadmap are controlled by some external organization (e.g. Sun!). That's IMO not the right thing to do, because it relinquishes control of the eventual destiny of the technology to a body other than the OpenSolaris community itself, which deserves the stake.”

[EL, cab-discuss, 23 Mar 2007]

Here we have a clear articulation of the need for a way to foster the “sense of ownership” that

[5]The symbol “>” is opening the rows part of messages quoted by the writer.

AH was talking about before: controlling the technical choices. This, in the process of building a collective, is a way of defining a hierarchy among different choices, and is therefore crucial to the future development of the project. The structure of the OpenSolaris collective is organized as “Communities” and “Projects”, the former supervising a general area of software development, while the latter are specific software development efforts. Indeed, with Communities, we have formal ownership, which has the power to decide the future of parts of the OpenSolaris project, while the Projects are explicitly connected to work, to production. Therefore, as EL pointed out, to strengthen the sense of ownership it should be clear who is in charge of future development, and of the roadmap for the project, while strengthening projects alone could suggest that someone else is running the entire OpenSolaris effort. Nevertheless, until now it has not been clear “who” is a legitimate participant in the OpenSolaris project, while “what” can participate has become clearer: an open source control management system, an open website, and a clearly defined distribution of competences and roles among communities and projects. Understanding who can participate in the social processes of collective ownership means, from this point of view, understanding who can participate in communities and projects in the OpenSolaris organization.

The OpenSolaris Constitution tries to answer such questions. Article number 2 elucidates the broad responsibilities of the Community, taking all the decisions regarding OpenSolaris, and how this Constitution relates to these responsibilities, defining the procedure for decision-making in order to sustain itself as a self-governing organization. In particular, the OpenSolaris Community is considered to be an organization that comprises volunteers who may vote on decisions involving the whole community, the most prominent of which is considered to be the election of the OpenSolaris Governing Board. The right to participate in such decision-making processes is restricted to a select group of people, the “Core Contributors”. To gain the status of Core Contributor, an individual needs to be recognized by at least one Community Group as someone contributing to the achievement of the goals of that Community (Article 3). To obtain this recognition, an individual must participate in discussion and development. Participation is restricted to those who have registered through the OpenSolaris website. There is, therefore, a social process of mutual recognition that creates a foundation for controlling the future of new development efforts and for the project organization. Nevertheless, the future of code is regulated by other means as well, mainly by the license, and understanding the controversies around the license can help with understanding the future, not only of the OpenSolaris code, but also of the relationship between such code and other entities in the software panorama.

Shaping the Software Panorama

At the beginning of 2007, while the GNU GPL v3 was under development, a debate emerged in the OpenSolaris community about whether to change the license of the project to the GNU GPL v3 or to a dual licensing schema. The current license of the project is (and was) the Common Development and Distribution License (CDDL), based on the Mozilla Public License, and therefore incompatible with the GNU GPL. As highlighted in other studies, this is a crucial political issue in defining which are to be the legitimate participants in a FLOSS project (De Paoli, Teli, D'Andrea, 2008), but what is important in this context is how the controversies about licenses shape the whole software panorama. In these controversies, the software panorama is part of the practice of debating as an element of proof, and its nature as an element of proof supports one group or another in the software panorama. Take the following example of a discussion about the GNU GPL 3 versus the CDDL as the right license for the project:

> “Wrong. Apple, FreeBSD and other projects are *proof* that the CDDL provides benefits. We do not have "just opinions, emotions and fear." I mean really, that's just an ungrateful and untrue thing to say.
>
> Debian doesn't even accept some of the Free Software Foundation's licenses, so what's your answer to that? Sorry, but Debian is unreasonable in their demands in many people's opinions. Why do you think Ubuntu is succeeding where they *failed*?”
>
> [SW, osol-discuss, 31 Jan 2007]
>
> “It is? When I see changes from Apple that get put back into the source base, I'll believe it. As it is, Apple is good about sucking the living daylights out of the open source community and putting nothing back, it's mostly a one-way street. I'm not saying their way is bad, it's just not open and free.”
>
> [AD, osol-discuss, 31 Jan 2007]

Debian and Apple are redefined with regard to the legitimacy of their practices: if Debian can be considered unreasonable, Apple is described as benefiting from FLOSS without giving back, thus not being legitimate. When the practices and histories of these entities are given as proof supporting the views of one of the debating factions, they are at the same time being evaluated in ethical terms, and their legitimacy as participants is hierarchically dependent on their ethical legitimacy, i.e. on their being “open and free”. This series of controversies ended with a document by the OpenSolaris Governing Board, entitled “Topic: Should OpenSolaris be dual licensed via CDDL and GPLv3” that states, among other things:

> “Further discussion on GPL* is merely a diversion and distraction that should be discouraged, so as to allow the community to concentrate on the higher priority action items - especially those that will improve developer mindshare.”
>
> [AH, osol-discuss, 7 Feb 2007]

As we see, here the controversial issue about the GNU GPL is dismissed in favour of getting other things done, with the aim of establishing an agreement among developers. Nevertheless, it is the same position paper that is questioned later on:

> “I support the OGB issuing position papers on behalf of the OpenSolaris community, and I think many people in the community welcome the board's view. I certainly respect the OGB and the individual members as well. However, I disagree with some elements in this OGB Position Paper.

> In parts, this document attempts to thwart conversation on OpenSolaris, and I don't support that strategy under any circumstance – especially since so many of us have worked so hard to have /open/ conversations. Also, the OpenSolaris Community is nascent, and I believe we should /encourage/ conversation, not /discourage/ it – no matter what the issue is as long as the conversation is respectful."
>
> [JG, osol-discuss, 10 Feb 2007]

Here, what is at stake is the possibility of continuing with the discussions – not the final decision, but the supporting arguments. The ability of participants to introduce perplexity should be preserved, although there is a recognition of the institutionalized authority of the OGB to make decisions about hierarchy.

FLOSS as Collective Ownership

While telling the story of Sun, Solaris and OpenSolaris, and talking about some of the controversies that emerged in the first two years of the project, I have underlined the process of defining legitimate participation in a FLOSS project in the context of a corporation. Some of the practices have been shown to be relevant in revising the boundaries of the legitimate participants and in defining which should be the legitimate aims for the project. These can be seen as "practices of freedom", things necessary for a group of people in order for them to define legitimate forms of existence for themselves and their political society (Foucault, 1984). In such practices, what is at stake is the construction of the OpenSolaris project as a collective, an ensemble of human and non-human entities, shaped by the processes of perplexity, evaluation of pertinence, construction of a hierarchy, and institutionalization.

In considering the issue of perplexity, I have pointed out at least two important elements in introducing perplexity to the process of constructing a collective: crisis and an environment that supports discussion. Whereas Sun was almost forced to rethink its own software development and distribution practices after an economic crisis (the bursting of the "dot-com bubble"), once the OpenSolaris project was launched, the practices of perplexity moved to the mailing lists. Here, the introduction of perplexity happens through two main channels: the role of artifacts and the initiative of a participant. In the discussion about the Charter and the Constitution, it was the nature of these legal artifacts that put Sun's behavior under scrutiny. By contrast, a question about the GNU GPL was transformed into a big controversy, and ended only with authoritative action from the OGB, the group of people formally in charge. Nevertheless, the same concluding document was questioned through the mailing lists, and the fact that this happened undermined one of the basic elements of the argument by the OGB itself. In the end, an open mailing list can become a key element in introducing perplexity, but it is still unclear what is relevant when evaluating pertinence.

As the history of Sun and the slogan "The Network is the Computer" show, the historically stabilized discursive resources are probably the key elements in defining pertinence. The connection with the idea of distributed computing, the presence of other examples of networked phenomena, and the possibility of finding a similarity for the proposed business model were crucial in enabling Sun's managers to promote the FLOSS option. This is also crucial when dealing with creation of a hierarchy: in the GNU GPL/CDDL debate, the presence of stated aims, like producing software, is the key in the discussion about the OGB position paper, as well as the main resource for the critique of the same position paper.

With regard to institutionalization, I showed how it can cause conflict, even generating such conflicts, as in the cases of the Charter and the Constitution. Moreover, the power to interfere with this project is institutionally granted to a restricted ensemble of people, the Core Contributors, while existing institutions (for example, the stock market, shareholders and investors) affect the way in which perplexity and pertinence may also enter into the process of constructing the collective known as the OpenSolaris Community. In fact, some elements were excluded during the process of alignment among the different participants, like the GNU GPL v3, proprietary parts of the technological infrastructure (for example, the source control management system and the website), the unbalanced relationship between Sun and non-Sun engineers, the absence of a shared roadmap, and unhelpful discussions.

In conclusion, the process of construction of the collective that exercises ownership over the OpenSolaris code is a process based on a number of elements: (i) historical events (the dot-com bubble bursting and the creation of GNU GPL v3), (ii) artifacts (legal documents), (iii) a technological infrastructure (the mailing lists) to support the critique of its current status, (iv) the existing documents, narratives, and the surrounding software panorama (other companies and other open source projects) in order to establish pertinence and hierarchy, and (v) existing institutions that support the same process of institutionalization of the collective, undermining the claim of radical innovation in favor of defining it as a form of improvement on the existing one, by means of perplexity.

Conclusions

At the beginning of this paper, I described how many researchers agreed on identifying FLOSS as an example of radical innovation in contemporary production processes, in particular in relation to the concept of property. After that, I explained the causal relationship between property and the organisation of production that the literature on FLOSS has developed, identifying three approaches: the ontological approach, the consequentialist approach, and the practice-based approach.

Starting with the subject of property, I have shown how property in the legal sense, and ownership as a form of power and control, should be separated, giving new meaning to the question “who owns software?”. In order to give an answer to this question, I have drawn upon the idea that ownership in FLOSS is shared among different people, who can be considered as a collective, i.e. a group formed as a result of practices of perplexity, pertinence, hierarchy, and institutionalization.

This theoretical framework was adopted to deal with the case of a corporate FLOSS project: the OpenSolaris project launched and backed by Sun Microsystems. Interpreting the empirical case, it has emerged clearly how a “sense of ownership” is something that is looked for by the developers, and that this sense of ownership should be shared among the collective entity known as the OpenSolaris community. Therefore, to answer the question “who owns software?” means to answer the question “who and what are the legitimate participants in it?”, in other words, who and what are included in the collective.

In this case, the answer resulted in a group with unclear boundaries, which are continuously being challenged by the introduction of perplexity about the components of the collective. Moreover, the previously existing artifacts, institutions, and discursive resources have been crucial in supporting the practices of pertinence, hierarchy, and institutionalisation, favouring an incremental critique of the status quo rather than a radical change to it. Future critical research might, therefore, start from this point of view: identifying the panoramas that may be affected and changed by FLOSS development and practices, while the possible pertinence of FLOSS practices to such panoramas should be evaluated in order to obtain an effective critique.

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**Expanding Open Source into Other Domains:
Analysis of Open Source Biomedical Research**

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Abstract

The paper aims to discuss and analyze the adoption of Open Source model of economic value creation in the biomedical research domain. It starts by evaluating the needs for open and collaborative models in biomedicine. Initial experiments using open and collaborative research methodology are discussed. The paper analyzes how open source design principles are suitable in the case of drug discovery. Two important initiatives of drug discovery (Tropical Disease Initiative and Open Source Drug Discovery) were studied under various open source design perspectives. The paper concludes that the open source biomedical research model is worth pursuing.

Keywords: Open Source Software, Tropical Disease Initiative, Open Source Drug Discovery, Biomedical Research

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Introduction

The concept of Open Source Software (OSS) has been gaining heavy attention predominantly in the last 10 to 15 years. In brief, the term "open source software" refers to software products distributed under terms that allow users to use, modify and redistribute the software without requiring that they pay the author of the software any royalty for engaging in the listed activities.

Products such as the Linux operating system, the Apache web server, the Mozilla web browser, the PHP, or Perl programming language, the MySQL database, and the OpenOffice productivity suite are well known examples of this kind of software. Popular open source project sites such as Sourceforge (www.sourceforge.net) and Freshmeat (www.freshmeat.net) have amassed a large number of licensed user-base along with a significant number of OSS projects. Sourceforge has more than 170,000 projects and more than 1,000,000 licensed users while Freshmeat has more than 45,000 projects with about 400,000 licensed users.

Formal definitions relating to the term "open source" are maintained by the Free Software Foundation (FSF) and Open Source Initiative (OSI). The definitions given by both the organizations are identical except for a minor difference in their emphasis. The FSF prefers the use of the term "free," which explicitly refers to freedom, while OSI emphasizes the availability and modifiability of the source code. Both the definitions put equal emphasis on the way the OSS community views the term "property." The notion of property in OSS parlance is built around the right to distribute instead of the right to exclude.

The success of open source has significant implications for economic growth and the development of the software industry. However, the notion of open source is not just limited to software. If the open source process has more general characteristics, as a generic production process for knowledge that can spread beyond software, then the implications would be considerably larger.

The present paper is a discussion and analysis of the generalization capabilities of the OSS phenomenon. For this purpose, applications of Open Source principles in the area of drug research have been studied in detail through different perspectives. The domain of drug research was especially chosen mainly due to the fact that, in the last decade, many different open and collaborative experiments, based on open source principles, have been carried out in this domain. This paper is based on substantial literature reviews, which studied the various facets of open source drug research. This paper also poses various questions related to the applicability of the OSS phenomenon in areas other than software, some of which have been partially answered while for others the answers are yet to be found.

The remainder of the paper is divided into six sections: the first section discusses the need of open and collaborative research in biomedicines with the changing pharmaceutical industry as the backdrop. The next section defines open source for biomedical research. The third section looks at recent biology collaborations which represent some characteristics of open source. The next section looks in detail at two applications of OSS principles in drug discovery viz. Tropical Disease Initiative (TDI) and Open Source Drug Discovery (OSDD) using different perspectives of OSS phenomenon and how these nascent initiatives are addressing the needs of society, which big pharmaceutical firms have failed to address. The fifth section assesses the generalization potential of the open source phenomenon, based on the open source biomedical study. Finally, the last section contains concluding comments.

Biomedical Research: Analogies with Software Development

The Open Source movement in software has been become quite strong in the last several decades. In the literature, various attempts to explain its enormous success have been made. Different researchers in the fields of political science, law, human relations, sociology, and economics, amongst others, have dealt with issues such as: motivation, collective action, network formation, peer reviews, user innovation, and economic logic.

The purpose of this paper is to explore whether and how the core open source principles are generic enough to be translated into a new context and new domains. For the purpose of this study the area of biomedical research has been examined as an example of the generalization potential of Open Source.

A cursory analysis of the two fields is enough to show that there exists a strong analogy between software and biomedical or biotechnological research. Both disciplines have enormous potential to help solve critical problems of humanity. This potential can only be realized if a parallel innovation system can be built along with the current industry participants. Both industries are largely concentrated with the existence of oligopolies (few large corporate controlling majority of the industry). This implies that a disruptive innovation can threaten the existence of these large corporations (Hope, 2008). Both industries are dominated by the strong existence of IP regimes: patents in the case of biomedical research and copyrights in case of software.

These similarities lead us to delve deeper into the analysis of the applicability of the open source principles in biomedical domain.

Open and Collaborative Research in Biomedicine

It has been observed by industry pundits that the pharmaceutical industry is facing a productivity crisis. The rate at which the industry generates new products, specifically, the new molecular entities (NMEs) approved by U.S. Food and Drug Administration (FDA), appears to be shrinking. This decline occurred despite a doubling of research and development (R&D) spending by U.S.-based pharmaceutical companies (Cockburn, 2004). The big pharmaceutical companies have failed to address the vaccines needed to address third world diseases, such as neglected or tropical diseases as well as orphan diseases. This turned out to produce a market failure, as no firm has any monetary incentive to develop drugs for consumers who can't afford to buy them. Also, over the years, biomedical research has become increasingly proprietary and secretive. As the general nature of the research is cumulative, such a trend may impede future progress due to access and licensing difficulties. To understand the reasons behind these issues and how open and collaborative research is an apt solution, as it is necessary to understand the different aspects and trends prevalent in the pharmaceutical industry.

Market and State Failure

There is a clear evidence of market and state failure in the production of third world diseases such as tuberculosis and Malaria. Market failure is evident because the patients in the third world countries do not have the resources to buy costly drugs that the large pharmaceutical firms might produce. Hence, even though the market (in terms of number of patients) is quite large, the limited purchasing power of this market makes this market non-lucrative for the big pharmaceutical firms and discourages any form of research.

The state has also not able to find any kind of solution to this problem. This might be partially because of a lack of will and interest, and partially because of a lack of resources and pharmaceutical infrastructure in the concerned third world country.

The unfortunate existence of market and state failure in the production of drugs to address third world diseases makes a compelling case for analyzing different, innovative approaches to drug discovery and to biomedical research in general.

Changing Nature of Patent Structure

For much of the twentieth century, biopharmaceutical innovation largely comprised trial and error by large, vertically integrated pharmaceutical firms. Through a combination of size and monopoly-conferring end product patents, these firms hedged the risk associated with their trial and error-based innovation.

In the mid to late 1970s, the advent of recombinant DNA and monoclonal antibody research caused the conceptual gap between research science and the therapeutic products of interest to industry to shrink. U.S. Congress passed the Bayh-Dole Act of 1980, which was aimed to encourage downstream commercialization by allowing patenting and exclusive licensing of federally funded discoveries. Before 1980s, the United States Patent and Trademark Office (USPTO) had a policy of refusing applications for patents on living organisms. From 1980s onwards, according to a historic result by the United States Supreme Court, living organisms that had been modified by genetic engineering or other means could now be regarded as inventions for the purposes of patent law. Combined with the Bayh-Dole Act, the effect of these judicial developments was two-pronged: on one hand, the biotechnology patents become easier to obtain and on the other, scientists were encouraged to seek patent protection for the research conducted with public funds. Additionally, the Court of Appeals for the Federal Circuit, created in 1982, has further encouraged proprietary trends in basic biomedical research by penalizing severely for any kind of IP infringement.

Due to this, universities as well as small firms could start patenting upstream research; that is the publicly granted research being performed at the university labs by research scientists. In the case of universities, licensing upstream research produces revenue. For small firms and startups, upstream patents – or exclusive licenses to upstream university patents – appear to be important for attracting venture capital and for securing revenues when licensed to large pharmaceutical firms. Thus the large pharmaceutical firms must now negotiate with a large number of universities and small firms due to their proprietary claims on the research inputs provided. This vertical disintegration in the pharmaceutical industry (with the addition of small biotech firms between academia and big pharmaceuticals) has created a heavy increase in downstream competition while increasing transaction costs substantially.

Tragedy of the Anticommons

A tragedy of the commons occurs when a common resource, such as air or water, is destroyed through overuse because no individual user has sufficient incentive to conserve it. According to Heller and Eisenberg (1998), a tragedy of the anticommons happens in the exact opposite case: when property rights on multiple components of a single technology are held by a number of separate individuals or firms. The development of a new product requires coordination among many different players. Due to the existing transaction costs, as the number and complexity of the negotiations increases so do the transaction costs.

This issue is highly applicable in the case of biomedical research because, due to a heavy increase in patent filing, fragmented ownership of patents in any innovation means that there is a significant requirement of coordination of property rights on multiple technology components owned by a number of separate entities.

The combination of these three trends -- the market and state failure in the production drugs to address third world diseases, the changing nature of the patent structure, and the pharmaceutical industry's increasing transaction costs which lead to the tragedy of the anticommons -- imply strongly towards a different innovative paradigm which is parallel to the current one. The paper further delves deeper into one such paradigm: an open and collaborative model of biomedical research. This is a model which makes scientists work outside their own lab or firm in an open environment, without secrecy and exclusionary proprietary rights.

According to Rai (2005), the rise for the need of open and collaborative biomedical research has coincided with two phenomena:

- Increased importance of computation in this research
- Emergence of Open Source methods of innovation in complex and computationally heavy areas such as software.

The next sections delve deeper into the various facets of open source drug research.

Defining Open Source for Biomedical Research

Specifically, for software, the term open source is limited to the software code. It simply means that the software code is bundled along with the application for the user to debug, change or redistribute.

To define open source for processes apart from software, this paper uses the definition of open source given by Benkler (2001):

(a) "Open Source" is a method of producing complex economic products;

(b) capable of supporting medium- to large-scale collaborations, potentially including thousands of people; and

(c) organized according to signals that are neither hierarchical commands (as in firms or academic laboratories) nor prices (as in markets) but voluntary or social.

This definition states that open source production needs focus – focus to produce an economic product, not just knowledge. It also involves large scale voluntary contributions from thousands of people and a that system facilitates such collaborations. The definition specifically does not emphasize intellectual property structure as such a structure varies for different groups which produce open source products. Applying a direct analogy, a drug candidate is an apt example in open source drug research which is being produced by thousands of collaborators voluntarily.

Keeping the above Open Source definition in perspective, we discuss recent attempts to import at least some open source features into biology.

Open and Collaborative Biomedical Research – Initial Steps

This section describes various efforts in open and collaborative biomedical research.

Bioinformatics Software

Many bioinformatics software projects, particularly small software projects, operate under an open source model. Some of the significant examples include Biojava, BioPerl, BioPython, Bio-SPICE, BioRuby, Simple Molecular Mechanics for Proteins, and Generic Software Components for Model Organism Databases ("GMOD"). These projects use a wide variety of licenses. Some include "copyleft" elements that require users who develop improved versions to share their code free-of-charge.

One important difference between most open source software and open source bioinformatics software is that the latter is publicly funded. Moreover, because most research universities require that employee rights to software developed using university resources be assigned to the university, the policy of universities towards open source software development becomes quite relevant. In many cases, these funding agencies (mainly universities) specify a single best license for the software.

Genomics Database and Alliance Projects

A second set of examples consists of large hierarchical team projects designed to acquire key data for an entire community.

The first open and collaborative genomic database project was the publicly funded project to sequence the human genome. The Human Genome Project ("HGP") was, from the outset, a collaborative endeavor. The intensity of the collaboration increased in 1998, after the project was faced with a challenge from Craig Venter, the leader of a private effort to sequence the genome. To meet this challenge, the public project streamlined the number of participants and further integrated its operations. The major sequencing centers – the so-called "G-5" – were required to report their progress in weekly conference calls with the funding entities, principally the National Human Genome Research Institute ("NHGRI").

True to the nature of the open and collaborative model, the producers of the human genome sequence did not simply put the raw data into the public domain. Rather, as the data were being produced, an open source software program, known as the distributed annotation system (DAS), was set up to facilitate collaborative improvement and annotation of the genome. DAS was designed to facilitate comparisons of annotations among several groups. The idea was that an annotation that is similar among multiple groups will be more reliable than an annotation that is noted by one group.

An extension to the HGP was the International Haplotype Mapping Project ("HapMap"). This project aims to catalog haplotypes -- patterns of genetic variation -- and link such patterns to disease phenotypes. The only structural difference with HGP is that unlike HGP, HapMap is based on copyleft licensing policy. The HapMap project is releasing individual genotype data as soon as it is identified. Before haplotype information has been assembled, it may be possible for those who access the data to take this data, combine it with their own genotype data, and generate enough information to file patent applications on haplotypes of interest. To address this possibility, the project has set up a "click-wrap" license that requires those who access the HapMap database to agree that they will not file product patent applications in cases where they have relied in part on HapMap data.

The HGP's legacy is also visible in The Alliance for Cell Signaling ("AfCS"), a government-funded consortium of nine academic laboratories working together to map the chemical inputs and outputs that control cell behavior. Cell Signalling, which is relevant to many complex diseases, is a much more complicated process. No single laboratory has the resources to address the complexity involved, making the collaboration of these laboratories essential. AfCS members are allowed to keep data confidential to preserve publication priority. But, members are required to place all data in the public domain as soon as their main major findings are accepted for publication. AfCS members also waive patents for any discovery that results directly from Alliance funds. The stated purpose of this clause is to enhance openness between members and eliminate administrative delays related to intellectual property protection.

In several respects, an open and collaborative approach to database generation and improvement has value. The approach allows for comprehensive database annotation and also provides an infrastructure of freely available scientific information that all researchers can use. But, unlike software, database generation requires substantial capital investments hence even though open and collaborative, database generation needs some kind of restriction on participation and also public funding. The need of public funding does undermine the ability of private businesses to form around databases. Unlike software, it is unlikely that private database businesses can be built on a services model.

In contrast with initial data generation, data annotation comes closer to the open source model. In many cases, annotators will be using publicly available computer algorithms to search existing databases for comparable sequences of known function. Thus, just as with software, the major expense associated with annotation is labor (Rai, 2005).

Open and Collaborative Biomedical Research – Applications in Drug Discovery

As we see in the section above, the existing biology collaborations either fail to fit the definition of open source previously mentioned or are too preliminary to evaluate. To assess whether the drug discovery process in biomedical research can be open sourced, we begin with the understanding of drug discovery pipeline and at what points the open source principles can be applied along the pipeline.

As detailed by Maurer (2005), the drug discovery pipeline consists of various tasks as mentioned below in that order:

- Basic Research**:** Undirected, curiosity-driven research into the mechanisms that cause disease.
- Finding Targets: Exploiting research to find a gene location, metabolic pathway, or other point where drugs can intervene to disrupt disease.
- Validating Targets: Using multiple, additional lines of evidence to see whether they support or discredit the hypothesis that a given target can be used to disrupt disease.
- Finding Lead Compounds: Testing chemical compounds to see whether they bind to an existing target and otherwise possess the properties needed to make an effective drug.
- Optimizing Lead Compounds: Systematically modifying and testing lead compounds to increase their effectiveness as drugs.
- Process Development: Developing procedures for making candidate drug in large, affordable quantities.
- Pre-Clinical Testing: In silico and animal testing to determine candidate drug’s safety and efficacy.
- Phase I to Phase III Tests: Testing the candidate drug on humans to search for side effects, efficacy and optimize delivery methods and doses.
- Approval: Paperwork and hearings to obtain FDA approval of the candidate drug for specified uses.

- Phase IV Tests: Testing on patients to confirm pre-approval test conclusions; demonstrate drug's efficacy in applications not previously approved by FDA.

After closer observation it can be noted that the tasks identified above can be divided into two groups viz. *Knowledge based* work and *Rule based* work (Munos, 2006).

Knowledge based work requires lots of intelligence and intuition, but little infrastructure. Examples include identifying targets, finding leads, and designing clinical trials or computerized disease models. It is about scientists leveraging each other's ideas, and using tools to gain deeper insights that might lead to breakthroughs. It can be thus seen that this work is ideally suited to the open-source model.

Rule-based work requires physical assets (laboratories, equipment, patients and so on) and money. It is tightly scripted and must conform to rigid regulatory requirements. Examples include toxicology studies, Chemistry Manufacturing and Controls (CMC) studies, and the conduct of clinical trials. Rule-based work is ideally suited to outsourcing, and much of it is already outsourced to contract research organizations (CROs).

Such division of labor suggests a business model where part of the drug discovery pipeline is open-sourced, while the rest is outsourced.

Before getting into the details of such business model, we note the similarities and differences in Open Source Software and Open Source Drug Discovery.

Similarities:

- Biology, like software, is an information oriented science. Drugs or pills like software consist largely of information.
- The R&D cost for drug development is considerably high. Per-pill R&D expenses are roughly the same as that of its manufacturing costs. With collaboration, the R&D expenses can be shared.
- Biology and computing are converging in recent years. In tasks such as lead generation, lots of computing power is indeed needed for processes such as data mining and visualization. The advances in these technologies make these tasks possible *in silico*.
- Tasks such as finding drug targets and identifying leads can be effectively done collaboratively.

Many authors such as Maurer (2008), Rai (2005), DeLano (2005) have studied the similarities. Along with these similarities, there are many differences, few subtle while few major, in the open source drug discovery and software processes as detailed below:

- Economic: For open-source software one needs only a laptop and an internet connection. With drug research, there are huge costs involved (more than US$800 million in some cases) for laboratory expenses and clinical trials.

- Research dynamics between the two industries also differ. Software development does not have a discovery phase. Once the objective is set, programmers set to work and make steady progress towards their goal. By contrast, drug discovery cannot flourish until a certain amount of knowledge about the target disease has been accumulated. That knowledge acquisition can take years or decades, with no way to know at the outset whether the store of knowledge at hand is nearly sufficient or not.
- Software development is also simpler: it spans only a few disciplines and has no equivalent to clinical trials. By contrast, drug development requires coordination of multiple specialties with little overlap.
- Drug R&D can go off-track more easily than software programming.
- In contrast to drug developers, software publishers are lightly regulated. They do not need FDA approval. One sloppy programmer seldom jeopardizes the achievements of others, and errors can be patched without requiring the rewrite of the whole program. With drugs, one careless worker can compromise years of work costing tens of millions of dollars.
- The two industries follow different intellectual property regimes. Software is protected by copyrights that arise automatically as code is written, even if nothing is filed. Drug research is protected by patents that are costly to file and maintain.
- Culture: Software industry has much open culture from the beginning while pharmaceutical industry has followed more of proprietary and secretive culture.

Drug Discovery for Neglected Diseases - A Case of Market Failure

We also examined one important observation regarding open source drug research. The pharmaceutical industry is averse to open source drug discovery, as it has incurred huge costs in discovering a given drug, for which it can charge minimal returns, as the drug production license is in the public. These huge costs are due to significant transaction costs and licensing fees that have simply become part of the cost of doing business. Although these costs have probably reduced profits, foreseeable sales revenues have been sufficiently high that the profit incentive has not been eliminated.

In contrast, according to Rai (2005), when follow-on research is conducted by a university or by a non-profit institutions that target the developing world, foreseeable payoffs are either highly uncertain or are clearly small. In these contexts, large transaction and licensing costs may pose a more pressing problem. On the other hand, at least in the context of low-margin research, it can be argued that an open source model of drug discovery may actually work. When the follow-on research in question is of demonstrably low commercial value, there is no reason for upstream researchers to fear that they are foregoing large downstream rents. Thus, even though conditions in the biotechnology sector may work against collective action, low-margin research may be an exception. Additionally, such a model is not a threat to the conventional big pharmaceutical firm's model as these niche markets are not the target markets for such firms.

In the context of all these observations, the paper enumerates two distinct initiatives being started in the last few years that adopt open source principles for drug discovery viz. Tropical Disease Initiative (TDI), and Open Source Drug Discovery (OSDD). Their business model is based on a mix of open-sourcing and outsourcing as mentioned previously.

Tropical Disease Initiative (TDI)

TDI is a decentralized, web-based, community-wide effort where scientists from laboratories, universities, institutes, and corporations could work together for a common cause (Maurer, Rai, Sali, 2004). The initiative was formulated to tackle the market failure for the tropical diseases. Only about 1% of newly developed drugs are for tropical diseases, such as African sleeping sickness, dengue fever, and leishmaniasis. The commercial model of big pharmaceutical firms only works if companies can sell enough patented products to cover their R&D costs. The model fails in the developing world, where few patients can afford to pay patented prices for drugs.

TDI's Model

The structure of TDI consists of a Web site where volunteers use a variety of computer programs, databases, and computing hardware. Just as most open source software projects start with a preexisting code base, TDI starts with a kernel of possible targets supplied by a core group of researchers. Individual pages would host tasks like searching for new protein targets, finding chemicals to attack known targets, and posting data from related chemistry and biology experiments. Volunteers could use chat rooms and bulletin boards to announce discoveries and debate future research directions. Over time, the most dedicated and proficient volunteers would become leaders. The drug leads which are an output of the TDI system would act as an input to the Virtual Pharma firm which would then choose the best candidate to work on it further with the help of corporate partners.

The model of TDI is cost effective. First, TDI would ask volunteers to donate their time (and any patentable discoveries) to the collaboration.TDI would offer non-monetary rewards to the contributors. TDI would restore competition which is curbed by the patent regime by making drug candidates available to anyone who wanted to develop them. Thus the R&D and manufacturing costs reduce. Also, the absence of patents would continue to keep prices low once drugs reached the market similar to that of generic drugs.

Open Source Drug Discovery (OSDD)

Similar to TDI, OSDD is a CSIR Team India Consortium with Global Partnership with a vision to provide affordable healthcare to the developing world by providing a global platform where the best minds can collaborate and collectively endeavor to solve the complex problems associated with discovering novel therapies for neglected tropical diseases like Malaria, Tuberculosis, Leshmaniasis, etc. It is a concept to collaboratively aggregate the biological and genetic information available to scientists in order to use it to hasten the discovery of drugs (Source: OSDD website).

OSDD Objectives

The Open Source Drug Discovery initiative would establish the open source platform to make drug discovery for infectious/ neglected diseases, cost effective and affordable to the people of the developing world. OSDD has independent biologists freely sharing their work through the internet. As a first phase, drugs against Mycobacterium tuberculosis including drug resistant and latent tuberculosis are undertaken with the following major objectives:

- Development of a web-based portal for data deposition, exchange, evaluation and tabulation for analysis
- Collaborative sharing of know-how for the entire spectrum of processes in drug discovery-- ranging from identification of drug-able nontoxic targets, *in-silico* screening of small molecules, lead optimization, pre-clinical toxicity and clinical trials
- To create a comprehensive Systems Biology approach for drug discovery
- Human resource development with emphasis on encouraging young minds
- Intellectual property protection to the extent it supports public good - One can apply for the Intellectual Property Rights, but these would be shared among the open source community.

OSDD's Model

In OSDD, the larger complex problem is broken into simpler, smaller set of activities which have a clear and well defined scope and deliverables. The smaller sets of activities are termed “work packets” or “work packages (WPs)”. This would enable to clearly specify the task to be carried out during the implementation of the project along with responsibilities for the respective WPs. The connections between the WPs describe the conceptual connections and the timings for their execution. Examples of WPs include Target identification, Screen development, Lead generation and optimization among others.

In OSDD, the entire process of drug discovery is divided into problems open for the entire community to contribute. An idea, software, data, an article or molecule(s) that help in expediting the process of drug discovery is treated as a contribution. The challenges pertaining to drug discovery are well-defined problems posted on the website. Anyone can solve these problems. Each of the solutions to these problems would be peer-reviewed. Appropriate rewards may be announced for solving them, similar to the innocentive model.

Rewards

A micro-attribution system is followed for all contributions. Based on the peer-review, contributors get rewards in form of credit points. Each activity or a defined problem has a pre-determined set of points or rewards associated to it. All probable prospective activity would be given prior points in terms of weightage, for example, lead optimization would have higher weightage than protein expression. The points can be accrued over time for all the contributions to the project. Based on the points accrued by the contributors they would be awarded four levels of membership cards (Blue, Silve, Gold and Platinum). Each type of card entails a certain sets of rights, privileges and responsibilities in the entire process.

OSDD – Computational Resources

OSDD aims to create a collaborative online platform for exchange of ideas, data and resources using web 2.0 technologies. Currently, in OSDD following web 2.0 tools have been identified:

- Sysborg 2.0: A Wiki based genome annotation service.
- Computational Resources for Drug Discovery (CRDD) which is a platform for interaction of open source tools for drug discovery.
- Open Access Archive for TB related research and documents
- Social Network for people who are a part of open source drug discovery.
- Eduspace: An online course portal on topics related to drug discovery.

Analyzing Open Source Drug Research under OSS perspectives

Motivational Aspects

General observers of OSS phenomenon are startled by the simple fact that large numbers of highly skilled software developers and users dedicate tremendous amount of time and effort to the creation, expansion and maintenance of OSS often for no monetary rewards. As explicitly detailed in the literature (for e.g., Sanders 1998, Perkins 1999, and Weber 2004), some people value non-cash compensation more than money. They volunteer their expertise to satisfy idealism or curiosity, seek new challenges, hone skills, build a reputation or enhance careers.

To understand whether similar motives are at play in the case of drug discovery, we look at various incentives for which an OSS developer puts his time and energy. According to Maurer (2008), there are certain typical incentives that are known to drive open source collaborations in software production as depicted in Table 1.

A few of these (e.g. production for the inventor's own use, production to sell a related good or service) seem to lack clear analogues in drug discovery. However, many other incentives do apply. For example, it is quite possible that biologists would join collaborations to learn new skills (education), demonstrate those skills to others (signaling), or donate their services from a sense of altruism.

In the world of software, companies are learning to use open source to their advantage, and many now allow their employees to participate in company time. They might use it to gain market share against entrenched competitors, or to entice developers to create applications for their product, possibly in the hope of turning it into a ‘platform’ as successfully shown by Red Hat. In the case of drug discovery, similar argument can be given. For drugs with commercial potential, employers could also pay employees to volunteer for sheer business reasons. For example, a firm could decide that open source collaborations were a good way to share costs with companies that do not produce competing products. Or it could decide that an open product would make its own proprietary inventions more valuable.

Table 1: Typical Incentives driving open source collaborations in software production

Incentives	Description
Own Use (Personal)	Writing software for one’s own use and enjoyment. Examples include hobbyists, developers (LINUX)
Own Use (Corporate)	Producing an open source product used by one’s employer. Examples include corporate webmasters’ creation of the Apache web server
Education	Producing an open source product in order to learn from experience and peer review.
Signaling	Producing an open source product in order to demonstrate competence to others.
Shared R&D Costs	Firms that do not compete with one another frequently use open source to share R&D costs.
Related Goods & Services	Producing an open source product which is needed to sell a separate, proprietary good or service. Examples include hardware (IBM) and customer training and programming services (Red Hat)
Social Psychology	Working for non-material rewards including reputation, altruism, and collective solidarity, among others.

Operating Principles

The above two initiatives viz. TDI and OSDD follow a hybrid operating principle of that of open-sourcing clubbed with outsourcing.

Open-sourcing

The open-source part of their model allows anyone who can contribute to join. Volunteers log on to a website, find the pages that matches their area of expertise, pursue challenges to be solved, review others’ contributions, download computerized tools and start working towards contributions of their own. All the initiatives are currently in nascent stage but it can definitively be argued that as the collaboration activity rises, more the volunteers can publish their findings in scientific journals and discuss their insights in on-line forums. Over time, the better ones will gain authority and become the leaders of their open-source community.

Outsourcing

The outsourcing part varies for each initiative. In TDI, the manufacturing part is outsourced to Virtual Pharmas while in the case of OSDD; the same is outsourced to CROs in the developing countries.

Business Model

Currently, both the initiatives are highly dependent on private, public, or government funding. TDI as well as OSDD can be highly productive if sponsors back them. In case of OSDD, the Government of India has committed Rs. 150 crores (US $38 million) towards this project. An equivalent amount of funding would be raised from international agencies and philanthropists. About 46 crores (US $12 million) has been already released by the Government of India. In both the cases, corporations could also help by donating funds, laboratory time, or previously unpublished research.

Unlike that of software industry, open source drug discovery depends heavily on funding at least in its formative years. Hence, sustainability of their business models still is an issue. To survive, they would have to replenish their portfolios and ensure that there is always a sound pool of contributors to perform the work that must be done.

In the light of these developments, there is a need for the pharmaceutical industry to review its business models. For the last few years, the traditional Risk-Innovation-Reward model followed by the pharmaceutical industry has stopped fetching timely rewards. Further to this, the concept of personalized medicine is slowly evolving in the pharmaceutical industry and is catching up fast in the healthcare industry. Decision-makers in the healthcare industry are seriously evaluating patient-centric strategies and in the not too distant future, these strategies will be implemented industry-wide. As a consequence, developing drugs customized to target populations and genetic traits will soon become the norm.

In such a scenario, the current "one-drug-fits-all" concept would be outdated and the traditional innovation-based business model will no longer hold good. Therefore, in enlightened self-interest, pharmaceutical majors will need to give serious thought to the open source model, and tweak it to suit their requirements.

Open source drug discovery brings with it many advantages to pharmaceutical companies and patients alike. The biggest advantage of this model being huge cost reductions, pharmaceutical companies can leverage the open source model to outsource the drug discovery process and save a fortune in the process. Some costs thus saved could be passed on to produce and market the final drug at much lower prices. Thus, open source proves to be the most viable model for discovering life-saving drugs. Further, the model can also be used to discover lifestyle drugs that pharmaceutical companies develop and market enduringly.

Reward Structure

According to Lerner and Tirole (2002), the OSS phenomenon has demonstrated that non-monetary incentives such as ideological satisfaction, the acquisition of new skills, enhancement of professional reputation, and the ability to advertise one's skills to potential employers are a good way to attract and motivate programmers. With the argument that similar incentives should work equally well for biologists, chemists, and other scientists, TDI offers similar non-monetary incentives.

OSDD has gone one step ahead in providing an additional monetary component along with the non-monetary benefits mentioned above. A micro-attribution system is followed for all contributions. Based on the peer-review contributors would get rewards in form of credit points. Based on the points accrued by the contributors they would be awarded four levels of Memberships cards (Blue, Silver, Gold and Platinum). Each type of card entails a certain sets of rights, privileges and responsibilities in the entire process.

Scope

In software domain, any open source project is focused on a particular specific problem which it tries to address. All the three initiatives in open source drug research focus on single disease or related illnesses. For example, OSDD is focusing on drugs against Mycobacterium tuberculosis including drug resistant and latent tuberculosis in the first phase. TDI focuses on different tropical diseases, it plans to establish separate website for each one.

Intellectual Property Ownership

Open source software licensing is based on some variation of the viral license called General Public License (GPL) that requires volunteers to offer any modified code on the same open terms as the original software. Traditionally, these licenses have been based on copyright. The situation becomes much more complicated, however, when one tries to build viral terms into a patent license. Also, in case of open source drug research unlike OSS, most open source activities occur at a pre-commercial R&D stage, when the ideas and hypotheses debated fall short of the legal standards that define inventions in patent law.

Hence, the licensing schemes do differ for each of the two initiatives. TDI has defined four possible licensing styles (Maurer, Rai, and Sali, 2004) as below:

- A public-domain license that permits anyone to use the information for any purpose.
- Licenses similar to the Creative Commons Attribution License that permit anyone to use the information for any purpose provided proper attribution is given.
- Licenses such as the General Public License that prohibit users from seeking intellectual property rights.
- Licenses that permit commercial companies to obtain and exploit patents outside the developing world.

In the case of OSDD, in contrast, the drugs developed would immediately become generics and hence the question of IP and patents does not arise. The licenses in the case of OSDD are similar to GPL license of OSS where there is an obligation to any user to contribute any addition or improvements made to the collective information back to OSDD.

Benefit for the society

OSS phenomenon has become hugely beneficial to the society. This relates to erosion of value of software product as the source code is openly available making the software product a commodity. This value erosion was indeed possible as the inefficiencies in the system have been squeezed out (O'Reilly, 2005). With commoditization of software, there is more and more competition. When the competition drives down the prices, the efficiency and average wealth levels go up. OSS phenomenon also helps customers in removal of lock-in and the problem that comes with proprietary technologies.

In case of open source drug research, consumers benefit chiefly by (a) low prices, which facilitate the widest possible consumption, and (b) increased transparency, which makes it easier to judge the quality of both existing and proposed products (Maurer, 2008).

Open source software also has disadvantages, most notably in its tendency to decouple product creation from the price signal and, hence, consumers' needs. Ironically, this is not always a disadvantage for drug discovery. Indeed, efforts by Western governments and foundations to find cures for neglected diseases normally assume that market-driven R&D signals are hopelessly inadequate and should be overridden (Maurer, 2008). Thus we can conclude that these initiatives would organize science in such a way that looks very different from today's commercial pharmaceutical world full of proprietary and secretive values.

Challenges to Open Source Drug Research

Despite the promises given by these three initiatives in Open Source Drug Research, there are various challenges that could affect their success (Maurer, 2008, Munos, 2006)

Availability of talent

Typical open-source software projects do not require a large number of contributors. Data from the software industry suggests that the ideal number ranges from 6 to 20 people. Yet much of the drug R&D expertise resides in an industry that has a strong proprietary culture. This could stifle talent supply in important areas of drug discovery pipeline.

An argument in favor of the availability of talent can be that a commercial pharmaceutical firm might encourage a researcher to contribute to open source drug research project if there is no conflict of interest as the firm might gain valuable goodwill by doing this.

Availability of data and standards

Open source scientists cannot accomplish much unless they can access data. Biological data is plentiful and getting richer, with terabytes of genomic and metabolic data continuously being added to the pool. Chemical and structural data, on the other hand, are scarcer. In addition, the formats used to handle these data are still evolving.

Availability of tools

Open source scientists need open source tools to practice their craft. Until recently, such tools were plentiful in bioinformatics, but less so in chemistry, which has long been dominated by commercial software. With the advent of PubChem in 2004 - 05 the scenario is changing. PubChem has brought online a powerful suite of tools that allows scientists to connect chemical information with biomedical research and clinical information in an unprecedented way. Other tools such as eMolecules, Jmol or the Chemistry Development Kit are adding powerful chemical search and visualization capabilities to the open source scientist's toolbox.

Architecture for participation

The design of the project's website is crucial. It must be engaging and appeal to visitors' curiosity. They must be able to quickly find the pages that match their interests, start collaborating. The architecture of these tools should be such that it facilitates participation from the users.

Quality assurance/quality control

For something as complex as drug research, quality assurance can become an issue. Oversight, due-diligence, audits, good practices and prior experience can be used to ensure quality.

Intellectual Leadership and Momentum

Enticing people to join is a challenge. A good website helps, but it's not enough. It takes a sustained effort to build trust with stakeholders. It also takes a leader who can connect with people, understand their motivation and foster trust. Linux attracts thousands of contributors because they identify with Linus Torvalds' ideals and trust him to do the right thing. Open source drug research needs to build such leaders.

Control of Intellectual Property (IP)

The entire momentum of the initiative, its current development thrust for a drug and the possibilities of follow-on research depend largely on the way its licensing policy has been formulated. Careful formation of licensing policy which determines who controls the IP is thus essential for the success of open source drug research.

Sustainability of the business model

As previously noted, the open source drug research is entirely a funded activity and its sustainability as a business model is in question. This is not the case in OSS as many open source business models have been tried and successfully tested.

Cultural Issue

The culture of the pharmaceutical community is not as open as is the culture of the computer science community. The same underlying norms of sharing that software developers built up and have are not available within the pharmaceutical community. Thus the researchers in drug discovery need to import these ideas from outside. Such cultural change might take significant time and energy.

After analyzing the open source biomedical research in great detail it can be safely concluded that even though the question of whether such open source model is likely to promote socially desirable biomedical innovation remains unanswered, the model is worth pursuing.

Because the model is quite fresh, and the time delay before research on this model can be translated into end products is long, empirical demonstration of the model's virtues and vices is, at this stage, practically difficult. Additionally, this model has produced software and genomic data that is usable, but the resulting public domain status for this software and data can reduce transaction costs and secrecy that may impede the follow-on research that leads to end products.

This model, far from being a threat to conventional drug research, could be a way to leverage big pharmaceutical's capabilities in order to tackle challenges that the blockbuster model cannot address economically, such as neglected or tropical diseases. This model is also a way to address the market niches that cannot support blockbuster drugs.

Assessing the Generalization Capabilities of Open Source Phenomenon

As we analyzed in the previous sections, the OSS phenomenon has clearly shown that there exists a complementary mechanism of economic value production which is governed by a set of rules and principles different than that of a firm. The reasoning behind the motivation and creative expression in OSS is vastly different than what exists in any firm driven by market forces. Firms and markets only tap into a piece of human motivation, a small part for any individual that makes him create.

OSS as an experiment has been successful in tapping a greater percentage of human creative motivation than is generally found in a firm setting. Thus it becomes highly interesting to understand how this phenomenon can be generalized and its scope can be expanded beyond software. To get a better understanding of this, we need to answer some of the following questions:

- How portable are OSS motivations and practices in other domains of economic activity and social organization?
- Do the OSS processes have general characteristics that can spread beyond software?
- What are the key criteria that need to be met for successful application of OSS principles in other domains?
- How can analytical models be built that try to specify conditions that favor or hinder the open source experiments in other fields?
- What is the nature of tasks where the open source process is more likely to work effectively?
- Under what conditions does the application of the OSS model obtain the best results in other domains?
- Whether the application of the OSS model replaces the existing paradigm or acts as a complementary, dual paradigm, which co-exists along with the old paradigm?

Apart from Open Source Drug Research, there are many experiments in various domains other than software which have taken place using the open source philosophy as mentioned below:

- Open Access (OA) is a parallel movement in the publishing industry where the open access literature is digital, online, free of charge, and free of most copyright and licensing restrictions. The movement, which was started in 2001, has grown significantly and now there are more than 10000 journals which publish their articles under open access licensing.
- Some other experiments on the lines of open source have happened such as "open-cola" alternative to Coke and Pepsi, an "openmusic" registry, an "openlaw" project at Harvard Law School, and other "open content" projects to build mass encyclopedias.
- Some other successful experiments which share one or more common properties with the open source process are Wikipedia (user collaboration), Amazon (user content and reviews), Innocentive (motivating the larger audience to work on a common problem), Google (PageRank algorithm built on the wisdom of crowds), SETI@HOME, Napster (peer to peer file sharing) and experiments in citizen journalism to name a few.

Many of these are simply open forums, in the sense that anyone can contribute anything they wish to a mass database. These projects gain their ideological inspiration from the open source process and tap into some of the same motivations. They also make good use of internet technology to organize voluntary collaborations. But these experiments are not organized around the property regime that makes the open source process distinctive. So, the experiment's alignment with the property regime is critical in building the generic models as necessary condition under which open source process would be favored.

The next step for the research in this area can be to initially study the domains in detail where the OSS principles have been adopted and make case studies, then identify the similarities and differences, strengths and weaknesses in those approaches. This would finally lead to building analytic models that try to specify conditions that favor or hinder the experiments in open source. Such a model needs to focus on few key factors which the transaction cost economics does not emphasize. These factors are detailed below:

- Relation between the problem solving innovation and the location of tacit information: If the information about the solution to a problem becomes more fine-grained, is individually differentiated, and hard to communicate, then there are higher incentives to shift the locus of innovation closer to users by empowering them with the tools for collaboration and easier modification. (Weber, 2004)

  We see this factor in action in the case of software where the programming logic is individually differentiated and also hard to communicate. This is also true in case of drug research where the range of knowledge required is vast and hardly overlapping, is individually differentiated and hard to communicate till the pre-clinical stage. Hence, if the tools are provided to the users for easy collaboration and modification, then it can act as a motivation to produce a valuable economic good.

- Need to solve a key market demand**:** Open Source models try to address certain critical and unfulfilled market demand for which the traditional approaches are deemed insufficient. In the case of software, open source models address the needs of the industry for the availability of source code along with the software for quick bug fixing, and removal of vendor locking. In case of drug research, open source models were adopted to address the market failure in manufacturing of drugs to treat neglected diseases.
- Cultural ethos**:** Cultural ethos plays a very important role in the success of any open source initiative. More the culture of sharing and collaborating imbueed in the contributing volunteers would invigorate such an experiment. In computer science, the culture of sharing and collaborating has been present since the UNIX days. Hence, adopting an OSS philosophy did not take much time. On the other hand, in drug research, the culture is mainly of a proprietary and secretive nature, making OSS model adoption voluntarily a time consuming job. Hence, we see many funded open source experiments in drug discovery but hardly any voluntary ones.
- Possibilities of network enabled collaborations and distributed innovation where a common good can be developed by discrete and disaggregated contributions spanning across geographies.
- Nature of tasks: The open source process is more likely to work effectively in tasks (or products) that have the following characteristics:
  - Contributions can be derived from the accessible, non-proprietary knowledge
  - Product perceived to be valuable for critical mass of users
  - Tasks are such that they require mainly two resources from the contributing volunteer, his time and energy.
  - Peer attention and review form the key elements in making the product better in terms of quality (efficient error correction) and faster in terms of its release.

- Product or task is benefitted from the positive network externalities.
- An individual or a small group can take the lead in building the initial core product around which a voluntary formation of community would take place for building the product further.

The tasks involved in Open Source Drug Discovery encompass many of the above characteristics. The development of drugs for neglected diseases is highly valuable to a majority of tropical countries. With the advent of various open biological databases, non-proprietary knowledge is available. Positive network externality exists as the drug candidates and annotations are improved by peer review and contribution. As all the steps in drug research cannot be entirely done by voluntary group of researchers, especially the ones after *in-silico* trials, large amounts of investment and funding are needed for any small group to put the initial efforts in building the community.

- Volunteer Costs and Aggregation Capabilities: As argued by Benkler (2001), the open source model can be suitably applied in the areas where the cost to volunteers of contribution is low and such contributions can be readily filtered and aggregated. Projects with these characteristics are likely to be superior to firms and markets in allocating human creativity.

  In biomedical research, data annotation in databases such as genome database or haplotype database is the right projects which have these characteristics.

- Motivations of participants: The open source process is more likely to work effectively when participants have the following characteristics:
  - The participants are well informed and knowledgeable so as to judge with ease the viability of the product being developed
  - The participants are driven by motivations beyond simple economic gains and have readiness for the reward cycle which is not extremely short.
  - The participants learn by doing and there is natural give and take of valuable information which benefits every participant.
- Formal architecture for participation: The contributions should have a legal structure in terms of its licensing scheme or property regime, which empowers users by providing equal access to all and also constrains anyone from putting restrictions on others in ways that would defeat the original goals.
- Business Models: Forming viable business model is of paramount importance for the sustenance of any activity, and open source is no exception. In the OSS arena, many business models have sprung up (of service and support providers, trainers, and value added resellers to name a few) which helped strengthen the adoption of OSS model. In drug research, as the open source initiatives currently are funded, and as the initiatives are in nascent stage, such models are not yet fully developed. Such public funding undermines the ability of private businesses to form around databases. Thus it is unlikely that in case of biomedical research, private database business can be built around services model. One area where the business models needs to get developed is the area of low cost clinical trials for drug candidate testing and approval.

These are just few of the indicative factors which might be helpful in performing detailed analysis of various open source experiments and to judge whether these experiments would indeed remain only experiments or they have the potential to shift the current paradigm.

Conclusion

This paper is a detailed discussion of the successful application of open source model to the domain of biomedical research. This paper studies areas in biomedical research where open and collaborative models have been adopted; either merely as an experiment or as a serious attempt to foster an adoption of open source philosophy and principles. This paper evaluates the needs for such adoption, its similarity as well as differences with that of open source adoption in software and various challenges. It also attempts to assess the generalization potential of the open source phenomenon in other domains.

It can be concluded that the open source biomedical research model is worth pursuing. Because the model is quite fresh, and the time delay before research on this model can be translated into end products is long, empirical demonstration of the model's virtues and vices is, at this stage, practically difficult. This model has the potential to act as a complementary drug discovery model along with the traditional one in order to tackle challenges that the traditional model cannot address economically, such as neglected or tropical diseases. A detailed empirical study of such model with reasonable amount of data is needed to conclude further. Finally, after the detailed study of open source biomedical research, the paper concludes that open source models have the potential to get adopted effectively in other industrial domains if certain criteria are met.

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**Open Source Approach to Public Policy:
The Cases of ERT and OLPC in Greece**

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Abstract

This paper attempts to shed light on the politics of open source by introducing elements of an open source approach to public policy and building on two relevant cases from Greece: the case of the digital archive of the public television and radio broadcaster ERT, and the deployment of One Laptop per Child project in two schools. The conclusions drawn from those cases can arguably contribute to far-sighted policies for development and innovation

Keywords: Greece, Open Source, Public Policy, Commons, Activism, ERT, OLPC, Education, Innovation

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Introduction

In recent years, a radical change in the organization of information production has been observed. The Open Source (OS) model has been of interest as an alternative mode of immaterial production (i.e. information, knowledge and culture) to scholars and practitioners. The online free encyclopedia Wikipedia, which manages information and knowledge, and the applications of FLOSS, i.e. Free/Libre/Open Source Software (for instance *Linux* and *Mozilla Firefox*), are considered as successful examples that follow an Open Source Approach (OSA) in their production and governance mode.

In this paper, the OSA has a twofold connotation. Firstly, it is related to the use of OS software applications, such as *Sugar* (*One Laptop per Child XO-1*'s software) or the OS video format *Ogg*, in public policy issues. Secondly, it refers to new modes of socioeconomic organization that share characteristics with those followed in the production of OS projects, i.e. collaboration; sharing; networking; use of legal forms like the *Creative Commons* or the *General Public* licenses; emergent consolidation of producer and user; and autonomy. The OS process, putting it into Weber's (2005, p. 14) words, is "a bet on the idea that just as important as the code itself and probably more fundamental is the *process* by which the code is built." This paper will try to take the point further and investigate how an OSA could influence the current public policy making, illuminating the politics of OS, based on two cases from Greece: the *One Laptop per Child* (*OLPC*) initiative and the case of the public, national broadcasting network *ERT*.

OSA and the Greek crisis

It is obvious that lately Greece has been facing serious socioeconomic problems. The national debt (rising from 216.9 in 2005 to 299.4 billion euros in 2009) is 12.5% of the National Gross Product while net revenues have decreased by 10 billion euros and expenditures have increased by 4.3 billion euros. Black economy; lack of transparency and subsequent corruption; bureaucracy; and nepotism, dominate the social, economic and political scene, tainting the internal legitimacy of the system. The private sector is closely connected with state activities, setting barriers to a creative and socioeconomically efficient competitive market. The interwoven problems of poverty; unemployment and precariousness; overlending; ineffective education, ineffective health and insurance systems, all need broad solutions and synergetic coalitions. It can be claimed that unless innovative approaches are adopted, the crisis will become deeper and deeper. What this essay argues – amongst others things – is that the OSA to public policy, although not a panacea, can offer certain solutions and serve as a stepping stone towards the betterment of not only of Greek society, but also of other countries facing similar problems. It can be argued that education, culture, and knowledge are the fields on which OSA can have the greatest impact. The OSA to information production and distribution can lead to economies of scale, and support the aggregation of sources in several fields of the economy, redistributing the surplus use value. However, it is evident that all the aforementioned ideas predicate strong political accord: failing to do so, the country will face the possibility of being marginalized in the processes of globalizing; countries with a level of development similar to Greece are in serious danger if they do not follow far-sighted policies in due course.

As mentioned above, the distribution of resources constitutes a fundamental aspect of an OSA. It has been claimed that such a mode of production, based on participation, collaboration and inclusion, can secure a more sustainable civilization (subjectively, concerning the consumption of cultural and knowledge goods; and objectively, i.e. where the physical Commons have become quite topical, especially with the emergence of the immaterial Commons sphere and the environmental crisis). The mode of production followed in OS projects (i.e. peer production) stems from modern productive forces which made possible, arguably for the first time in history, the wide distribution of the material means of production, and the chance for mass communication and collaboration among the consumers/users/producers, without the mandatory mediation of third parties. The OS movement is forming and is simultaneously formed by a new ethos of creation and collaboration: technological progress and the revolutionary element in the shift of the productive forces give rise to new relations of production. Surely enough, the OS movement is in its very beginning, but according to some analysts, it constitutes a revitalized continuation or a transcendence of the past emancipatory movements of the industrial age. It shows us that a new alternative mode of socioeconomic organization can exist beyond the state and the free market dogma, which, however, can co-function in a creative way with the former in a state of synergetic empowerment.

Next, the cases of the Greek television and radio public broadcaster *ERT*, and what is globally known as the OLPC movement are examined, where activism and civic mobilization have still not succeeded in transforming their rhetoric and initiatives, inspired by an OSA, into fruitful, large-scale results having a greater, more generalized impact on Greek society. However, the lessons learned and the ideas introduced by and through the experience of these cases can shed light on the strands of the politics of OS.

The *ERT* case: "Set it free"

ERT is the national television and radio broadcaster of Greece, for the moment part of the public sector and sustained by a form of obligatory taxation (incorporated within the electricity bill). In late 2007, the initiation of a project regarding the digitization of the old archives of *ERT* was announced; this project was completed[1] a few months ago. Although this move had been considered as a significant first step towards the public availability of a unique cultural wealth, the decision to stream the material over a proprietary, commercial product incited open/free, participatory/Peer to Peer (P2P) and Commons-oriented communities to protest. According to them, there is an "innocent fraud" behind this initiative: the digital archives remain an exclusive property of *ERT*. The story goes on as the patented formats *Flash Video* and *DV* have been selected to support the digitization of the archive, which is actually a Commons that Greek residents have been supporting both economically and creatively. In addition, supposing that *ERT* turns into a private company, then a

1The web platform, which contains the digitized archives, can be found at http://www.ert-archives.gr/ (retrieved 30 November 2009).

Commons may fall into private hands.

The Greek department of *P2P Foundation* (an Amsterdam-based open network of scholars, with the aim to research and document the open source/free/P2P alternatives and infrastructures, of which myself I am a member) took the initiative and with the support of several individuals and other open/free participatory communities, conducted A *Text of Propositions and a Starting Point of a Social Dialogue* (Papanikolaou, Stavroulakis, and Kostakis, 2008) asking for an open source, free archive. The full text/manifesto/petition follows, as it summarizes the main arguments for an open archive and, arguably, effectively conveys the feeling and the essence of such a mobilization:

> Let's set the *ERT* audiovisual archive free
>
> [A text of propositions and a starting point of a social dialogue]
>
> Greek citizens, but also citizens of other countries, we jointly sign this text on the occasion of *ERT*'s choice to distribute its audiovisual archive non-freely to the public. Our aim and ambition is to publicize our propositions so that they become the starting point of an open dialog among Greek society, the European and global public audience and to signal the revision of backward policies and the creation of common political wealth.
>
> Few days ago, the *ERT* administration presented the beginning of the availability, only via Internet streaming, of a part of its audiovisual archive. This move constitutes an important first step, which, however, in our opinion, is tarnished by the fact that the public availability of the archive is not made free, although the Greek and European citizens have paid their money to make the production and digitization of the archive feasible.
>
> If today, you store in your computer, or send to a friend, or allow your children to make a creative montage for their homework in the history course, using material based on this archive, you will have committed a list of offenses regarding the protection of "intellectual property". It is supposed you should not feel by no means proud for the creative concern of your children, who searched and reassemble the sources, because, from a legal viewpoint, they have committed a crime against the *ERT* archive. In fact, you are liable for the deficient parental responsibility that you have shown in upbringing your children.
>
> Don't you think this absurdity should stop?
>
> If you own an apple, you can decide either to eat the whole apple or to cut it in small pieces and share with friends. If you choose the former, your friends will not eat, but if you share the apple, all of you may remain hungry. This situation occurs in the case in which the material goods are limited with respect to the amount of needs. However, this cannot happen in the case of the immaterial and digitizable intellectual goods, including information that exists in abundance.
>
> If a large number of people, including you, have paid with your own money for the

production of a television or radio show, you surely have your say for how this show should become publicly available. If it is freely available to anyone who has got an interest in it, this does not make you by no means poorer, since it does not deprive you of the possibility to enjoy the same privileges with others. The nature of those kind of goods makes the competition among us nonsensical. To legally cast this modern reality, new forms of property have been established, whose main feature is that they are not exclusive, that is they allow the sharing of goods and at the same time defend in a better way some rights of the original authors. In modern legal terminology, these forms of property are shaped as licenses like the *Creative Commons* or the *General Public License* (GNU GPL).

All of us who sign this text believe that:

The ERT archive that was produced with the contribution of Greek citizens and today is digitized with the money of European tax payers, should become freely available to all the residents of the planet via the Internet. The availability of the archive suggests the availability of a precious cultural treasure.

Anyone should have the right to store, to copy, to modify and to redistribute this material freely without royalties or being obstructed by bureaucratic processes. The derivative products of this creative process are supposed to be freely available under the condition that these products will not become the exclusive property of anyone, but they will abide by the same legal status of free use. In this way, innovation and collective creativity are strengthened.

That such a choice better protects the public character of this wealth and brings the Greek culture to the public attention. In our times, in which the citizens concerned about the future, the defense, the depreciation and the sale of the public wealth to rich individuals, such a choice is the only alternative solution for guaranteed protection and efficient economic utilization.

That such a choice creates the yeast of growth in a pluralistic economy of private individuals, small and big companies and public institutions (local government, universities, research institutes, etc.), extends the market and cancels the entertainment and news update monopoly of those who possess a lot of money so that they can maintain big infrastructures and pay rights for utilizing the material. Such a choice constitutes, accordingly, an opportunity for empowering democracy in Greece.

That the release of public information creates multiplied economic dynamics that are distributed more equally for the citizens. It is a development opportunity for the Greek economy, much more important than the uncertain income *ERT* will enjoy if they choose to strangle themselves on the plea of exclusive property.

That it creates the best conditions for the dissemination and promotion of the Greek civilization that constitutes a pylon of the modern European and world civilization. That such a prospect creates multiplied derivative benefits for all economy sectors, particularly for tourism and the artistic and intellectual production.

> That the form used for the sharing of information should not rely upon proprietary models of digitization that make the public property dependent upon private interests, it should rely upon free and open standards to ensure full access to that information for all citizens.
>
> That in a modern democracy, such that Greece claims it is, the final decisions in critical issues that concern all citizens, or involve multiple partners with various interests, political parties or social movements, should be the result of an open public consultation. We ask that such process, although delayed, should begin today, in order to jointly shape decisions that can mark the prospects of our society in the long run.
>
> The struggle for free and full access to the public information is *fair*, *insistent* and *global*.

The digitized archive remains in the proprietary hands of *ERT*. However, in an era where new regimes of property, such as the *Creative Commons* (CC) or the *General Public License* (GPL), have been developed, the aforementioned enclosure sounds problematic. The citizen has limited access to the archive; although it is possible to see it, he/she is not allowed to use it freely, even for non-commercial purposes, without the written permission of *ERT*. This constitutes a typical case that reveals the essence of state/public property in modern Greek society. The property is exclusive and a bureaucracy manages it, while citizens have no authority in it. In the name of the so-called common property, the object is detached from its natural subjects. Often, as numerous cases have shown in the recent past, the state/public property, covered by the obscure veil of bureaucracy, becomes prey to some specific dominated interests. Nowadays, new property regimes exemplified by CC and GPL differentiate from the traditional concept of state property. These Commons-based property forms are against the private appropriation of the commonly created value, trying to create the widest possible usage while keeping the sovereignty with the individual (Bauwens, 2005a and 2005b). These new forms inaugurate the concept of common property; very different from the private property which is exclusionary (following the token: "what is mine is not yours"), and from state property, which, although a collective property, is also exclusionary ("it is ours, but the sovereignty is regulated by a bureaucracy or representative democracy") (Bauwens, 2005a and 2005b). The nature of the digital archive of *ERT* allows its reproduction and distribution via Information and Communication Technologies (ICT) with a marginal cost. The decision not to distribute the archive under Commons licenses imposes an artificial scarcity in a cultural wealth, which could be freely distributed to everybody and constitues a positive externality. Individuals would have the chance to use parts of the archive and creatively mix it, and redistribute it, under the same legal forms, to the Commons sphere.

The *ERT* archive was considered as the "Elgin marbles of modern Greek culture" (Papanikolaou, 2007) and the open/free, P2P communities in Greece tried through this to promote the discussions about an OSA to public policy. They asked for a generalized Commons licensing of all public data and information which is produced with public money; warned of the danger of archives' privatization; called for the adoption of OS software applications in the public sector; and denounced the then recent deal between the Greek state and *Microsoft* for covering the ICT needs of the public sector. After posting texts in several

Greek and foreign blogs and sending emails to many relevant email lists, the Greek activists tried to create a web platform at *setitfree.gr*, which, however, never went officially online, because when it was completed, people and mainstream media had already forgotten the *ERT* case; so, it was decided to quit such an initiative. In spite of the fact that this activist movement was ultimately unsuccessful, the message that it carried is arguably of a special interest to the scholars of OS politics.

Next, the *OLPC* case is investigated which shares some characteristics with the *ERT* case. The activists and the Non Government Organizations (NGO) behind *OLPC* initiative are still trying to transform it into a generalized movement with very interesting, though, for the moment, small-scale results.

The *OLPC* Project: *EEL/LAK, Re-public* and Two Schools

The OLPC XO-1

According to the official website of the non-profit organization *OLPC Association Inc.* (2009) the mission of the initiative is:

> to create educational opportunities for the world's poorest children by providing each child with a rugged, low-cost, low-power, connected laptop with content and software designed for collaborative, joyful, self-empowered learning. When children have access to this type of tool they get engaged in their own education. They learn, share, create, and collaborate. They become connected to each other, to the world and to a brighter future...It's not a laptop project. It's an education project.

The *XO-1*, known also as the $100 laptop, is the *OLPC* laptop (subnotebook type) with OS software. It is not just a cheap laptop: it is a tool for children (approximately of the age of 6-12 years old) that arguably leads to a new educational paradigm. It is based on an educational theory, called "constructionist learning" and developed by the computer scientists Seymour Papert and Alan Kay, which proposes the "learning by doing" educational process in a student-centric model instead of the traditional teacher-centric practices. The *OLPC XO-1* intends to foster individual and collective creativity, and to emphasize the value of the underestimated children's intellectual, learning and creative abilities. As Pavlos Hatzopoulos (interview, 2009), who is an *OLPC* activist and the managing editor of the online political journal *Re-public*, said: "the *OLPC XO-1* re-frames the role of the teacher as a collaborator of the students and a catalyst for creative learning". The XO-1 is shipped with a *Fedora GNU/Linux* version and a set of applications called *Sugar*, that enables collaboration amongst students. Next, based on interviews with some of the initiators of the *OLPC* movement in Greece as well as building on various theories about the OS model, the *OLPC* project is analyzed in its three main political dimensions: the access dimension; the educational dimension; and the FLOSS dimension.

According to Pavlos Hatzopoulos and Thanasis Priftis (interview, 2009), the editors of *Re-public* journal – which has taken the initiative in cooperation with *EEL/LAK* (the official institution for FLOSS in Greece) and has organized several relevant workshops freely providing schools with *OLPC XO-1* – the *XO-1* is not just an inexpensive notebook; it inaugurates a new educational paradigm while it offers ICT to every single child. Moreover, one basic principle of *OLPC XO-1* is the OS software it contains, making the child responsible for the maintenance, development and modification of its own laptop system.

Initially, *OLPC* was launched to provide children from the developing world with the basic ICT so as to be able to experiment, explore and learn. Therefore, one obvious dimension of the initiative is that it tries to fill the gaping chasm between the digitally illiterate developing world and the developed one, by providing access to ICT. This is the first and the most obvious dimension. However, in this paper, the analysis is concentrated on two other, less evident, political dimensions: the new educational paradigm on which *OLPC* is based and tries to promote, and the use of OS applications.

Open Sourcing Education: Towards a New Educational Paradigm?

The *OLPC* project is based on the educational theory of constructionist learning pioneered by Papert, and later by Kay. This theory views learning as the reconstruction rather than as the transmission of knowledge, and maintains that learning is most effective when the student experiences part of an educational activity as a meaningful product construction (Papert and Harel, 1991; Papert 1990a and 1990b). In constructionist learning, students draw their own conclusions through creative experimentation and the role of the teacher is that of the mediator, who assists them to understand the problems; and that of the learning catalyst, who guides them provoking individual and collective creativity (Papert and Harel, 1991; Papert 1990a and 1990b).

In the industrial production of the 20th century, the dominant educational model was engrained with similar "industrial" principles: leader(teacher)-centric, strict hierarchies with pathetic students-workers-objects. According to Hardt and Negri (2001), society, thus the educational system as well, reproduced the figure of the factory which was the representative agent of the dominant mode of production, i.e. massive industrial production. In the era of information production, where immaterial value is of a great importance and is produced (not solely) through OS modes of production, new educational paradigms are emerging. Their application now seems more possible than ever. It can be said that the 19th-20th century's typical classroom followed an industrial organizational mode, with most of the children feeling unease when going to school (like the industrial worker who dislikes his/her work) and enjoying a small degree of autonomy and cooperation (alienating from each other, many times, in the competitive strive for grade chasing). Today, what *OLPC* could lead to, is an OS educational paradigm which enables the co-existence and experimentation with different learning practices – say, learning from the teacher, learning by doing and P2P learning (learning from the fellows students) – while it is built on the idea that just as important as the knowledge (code) itself and probably more fundamental is the process by which the knowledge (code) is built (in all, fostering critical thinking and individual and collaborative learning).

Next, I consider the cases of Florina and Sminthi schools, both frontier places in Greece, where efforts to apply some of the practices of constructionist learning with the help of *OLPC XO-1* shed light on what is the potential of the *OLPC* vision.

The Cases of Sminthi and Florina

To begin with, it is important to say a few words about Florina and Sminthi in order to have an idea about the essential socioeconomic background. Florina is a small city whereas Sminthi is a mountainous village, both in the frontline of northern Greece. Greece – although having made significant progress in Internet access and ICT infrastructures during the last years (indicators concerning individuals, enterprises, and state are available at the measurement of *eEurope/i2010* by the *Observatory for the Greek Information Society*) – still has a long way to go in reaching the EU standards. Sminthi and Florina, as frontier, often unprivileged places, are below the Greek average level. Further, it should be mentioned that all the information about the experience of *OLPC* in Sminthi and Florina was drawn from interviews with Yannis Kaskamanidis from Florina, Pavlos Hatzopoulos and Thanasis Priftis of *Re-public* journal, and relevant workshops held in 2009, organized by *Re-public* and *EEL/LAK* (I was also responsible for the organization as *Re-public'*s external collaborator), in which teachers from the aforementioned primary and junior high schools participated and shared their experience.

The students of the public junior high school of Sminthi are all members of the Muslim minority population and their native language is Turkish or Pomak (a Slavic dialect). The demographics of the school, which is not an international school but a national, Greek one, is of special interest: amongst 140 enrolled students, who come from 15 adjacent villages, there are only a few girls, as their families do not allow the latter to go to the junior high school. Most of the students have very serious problems in reading and writing in Greek whereas their teachers are Greek and do not speak Turkish or Pomak. Thus, the language barrier had to be transcended by alternative teaching methods and approaches. “Students accept us”, said the high school teacher of Mathematics Dionysia Psychoyos, during her speech (2009a) in a small-scale workshop in Athens, before her school gets the *OLPC XO-1*, “because they consider us as something strange from the outer, modern world”. “Even having a ruler or a bow compass is a big deal for students there”, she complained, “so, we, teachers, have to bring them all those things...even to provide them with papers and notebooks!”. Psychoyos highlighted that what was needed was not new content (say books) or other particular tools, but a kind of platform that would allow for improvisation and adaption to the conditions each time. “I think that a computer, like *OLPC*, can serve as the platform which I refer to... and, after all, the IT course is a students’ favorite. Moreover, I already know how to use *OLPC XO-1* in lessons such as Geography or Mathematics”. On September the 15th, 2009, several *OLPC XO-1* arrived at Sminthi school and, as Psychoyos (2009b) wrote the very first day to the Re-public team: “I won’t say that there was a fuss; on the contrary, students were speechless. They didn’t know about that and it was hard to believe that they would own those laptops for one school year! It was really amazing how quickly children became familiarized with them... When the bell rang for break, Cezer, who is the naughtiest student, cried: “What a pity that the bell already rang”... Tomorrow, we are going to form the plan according to which the laptops will be used”. After some weeks, Psychoyos (2009b) wrote again about her first impressions: “Children are passionate about their new laptops, exploring *XO-1*’s features... They search for wifi networks, which unfortunately are very hard to be found here, and have tried all the applications of *XO-1* so far... In addition, they have learned how to delete and restore the applications... The laptop has created a collaborative environment and surprisingly the class is more concentrated on the lesson and much calmer”. And the highlight, according to Psychoyos (2009c), is that one day when she was late in class, students complained because time was lost from their course.

The case of Florina is different and much simpler. The primary school of Florina, which could be characterized as ordinary school of the Greek countryside, in terms of demographics, but above the average, in terms of equipment, had already made significant steps concerning technological tools (such as the interactive board or some simulated animations via Internet concerning physics experiments) already in use by the time the *OLPC* laptops arrived. This means that – as Yannis Kaskamanidis, the IT teacher of the school, pointed out – apart from the students, who were already familiar with ICT in class, “before we get the *OLPC*, we already had a well-educated and informed teaching staff which had been collaborating with parents; the schedule was flexible and carefully formed... So, the *OLPC* did not suddenly fall from the sky (2009, interview)”. The first reactions of the students, when they received the computers, were the same as those in Sminthi, as the IT teacher stated (2009, workshop). In his presentation at the Goethe Institute in Thessaloniki (2009) as well as in our interview (2009), Kaskamanidis explained more about the operation of *OLPC* outside and inside the classroom: “The *XO* is not a laptop for students, but a student laptop... They [the *OX* laptops] have been successfully used for reading, text editing, graph understanding, drawing, video and photographs viewing, memorization, chat and communication... Children are passionate about applications such as the *Turtle*, *eToys*, *Pippy*, *Scratch*; they realize the potential of each tool and together we configure it according to our needs; that’s one of the reasons why I am a strong supporter of OS”, he would contently add with a low, but confident voice. “Some of the conclusions, so far, are that children are more enthusiastic about going to school... more concentrated on the lesson... they are not late... they want to get the *XO* at home... children’s spelling and writing skills have been improved in a short time... they enjoy creating contextual maps like the application *Labyrinth*... (and) children have developed a collaborative mentality”. When asked for the (new) role of the teacher and the (new) relations of the students in a constructivist learning paradigm, which the *OLPC* projects tries to propagate, Kaskamanidis (2009, interview) replied that the issue is actually political, because while living in the Greek society that faces a deep crisis, children should not be asked to reproduce its images. There new roles for everyone: “firstly, a new role for the teacher in an effort to create a scientist, a scholar, say, a “mature kid” whose role is to catalyze learning... and then, the spirit of cooperation that this new educational paradigm gradually fosters seems to enable the “weakest” to participate in a collaborative process; say, the editing of a text”.

In general, beyond the mentioned problems of familiarization; some worries and doubts from a few parents and from sections of the local societies; occasional exploitation of the new type of (more equal) relations of the student and the teacher; both cases prove that, for the moment, the introduction of *OLPC* is successful and has been embraced by students. The next section discusses the third dimension of the politics of OS, i.e. the adoption of OS software (FLOSS) applications in education.

FLOSS Software in Education

The adoption of FLOSS in the processes of all levels of the education system is undoubtedly political: one could argue that, for two main reasons (the reason why, in this paragraph, the word FLOSS is used instead of OS software, is in order to stress its, in parallel, political, ideological and technical dimension).

Firstly, it is obvious that the dependence upon proprietary software creates dangerous monopolies for the benefit of monopolistic producers, who own and manage the source code. In a world where there would be no alternative to these, the adoption of proprietary software is, although problematic, inevitable. Nowadays, however, with the myriad of OS applications available, the adoption of FLOSS in education is not only a cost-saving step (evidently saving considerable amounts of money for governments, individuals and enterprises), but it is an investment in society, as FLOSS is a good produced for and by the Commons sphere. Extensive argumentation for FLOSS, and against proprietary software has been developed elsewhere in the literature (see for instance the papers of *GNU - Free Software Foundation*[2]). Hence, when children will be nurtured in a FLOSS environment, then the problems encountered while trying to shift from proprietary software to FLOSS disappear (for instance, many face serious problems when trying to move from *Microsoft Windows* to, say, *Ubuntu* and as a result they remain trapped into a proprietary operating system; most of them do not even try such a change).

Secondly, there is another reason why the adoption of FLOSS is political, which is not of an ideological, but of a pedagogical and social capital nature. Pedagogical because the student, from an early age, is responsible for the maintenance, development and enhancement of his/her own FLOSS equipped computer (see the above section about *OLPC*). Arguably, the aforementioned is a long-term boost for knowledge economies and simultaneously elevates and enriches self-expression, creativity and independence in a highly inter-connected world. It becomes evident that the ability (and the right if seen from a more ideological perspective) for the student to modify, collaboratively or individually, his/her software is a social capital investment, which fosters the ground for future social innovation.

It is worth mentioning the words of Yannis Kaskamanidis, the IT teacher of the school of Florina, during our interview (2009) when discussing about the FLOSS in education: “The *XO* and the FLOSS illuminate the essence of the common/voluntary labour. Students realize that amongst the firms and the individuals who strive for financial gains, there are also communities consisting of volunteers that create superb educational software. This [he means the FLOSS and the *OLPC* project] serves as an ideal opportunity to spread the ideas of solidarity, reciprocity and voluntarism... [and] to show them [the children] that although happiness is experienced on an individual basis, it a social issue”. It can be argued that the main vein of Kaskamanidis’ articulation comes in accordance with several scholars (see for instance Benkler, 2006; Bauwens, 2005a and 2005b; Lessig, 2004) who maintain that the case of FLOSS and Commons-based peer production should be seen in the broader spectrum

2The webpage of GNU Free Software Foundation at http://www.gnu.org/ (retrieved 6 December 2009).

of a new social, economic and political paradigm.

Conclusions

The title *Open Source Approach to Public Policy* is used to capture the political issues related to the adoption of OS technologies and of those modes of organization which are based on collaboration, individual and collective creativity, sharing, openness, and autonomy. The *ERT* case contributes to the redefinition of the state/public property in the light of the Commons-based property regimes concerning public goods. In the former, although allegedly "public", the property is exclusive while in the latter, the individual has sovereignty. Moreover, as explained through the narration of the first case study, the adoption of Commons licenses for an immaterial – thus in abundance, with zero marginal costs for reproduction – public good can create several positive externalities and empower social production. The case of the *OLPC* project in Greece serves as a chance to discuss the political dimensions of this international initiative. The access, educational, and FLOSS dimensions are seen under a political spectrum. Firstly, the *OLPC* project contributes to lessening the gap of access to ICT between the developed and the developing world, and enhances digital literacy amongst children worldwide. Secondly, the use of the *XO-1* in class leads to a new educational paradigm, named "constructionist learning", in which the roles of teacher and student are redefined. The cases of Sminthi and Florina schools prove that the *OLPC* project can effectively transform the education process by "open sourcing" it. And last but not least, the adoption of FLOSS in education damps the dangerous dependency on proprietary software, invests in human capital and creates a sense of autonomy and solidarity. However, initiatives like *OLPC* or the adoption of Commons-based property forms should be part of a far-sighted, broader political strategy; for countries like Greece, which are in a deep socioeconomic crisis, a generalized OSA to public policy may offer chances for innovation, recovery and development.

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Promoting Open Source Software in Government: The Challenges of Motivation and Follow-Through

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Abstract

Open source software has long been used by government agencies, and prospects for increased use have been greeted enthusiastically by both knowledgeable government employees and open source communities. But mobilizing the necessary forces in government to procure open source software has proven difficult. Instead of a vague statement of principle or a naïve focus on cost reduction, government agencies should review and focus on core responsibilities to the public: access for all, vendor independence, archiving, special government needs, and security. Managers promoting open source should gain insight into how it is produced and what its adoption entails, while a statement explicitly political goals provides the necessary motivation to carry through with the project. This paper also shows the relationship of open source software to open government, discuss the importance of open standards to the adoption of open source, and stress the importance of a robust requirements assessment, highlighting models from the Department of Defense, the Commonwealth of Massachusetts, and the city of Munich, Germany.

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Open source software[1] has long been used by government agencies, and prospects for increased use have been greeted enthusiastically by both knowledgeable government employees and open source communities. But mobilizing the necessary forces in government to procure open source software has proven difficult. This paper explores the reasons so many efforts have stalled, and the lessons taught by the successful efforts. It will cover:

- Reasons for adopting open source software that are particular compelling in a government setting
- The relation of open standards to open source software and the importance of standards to the adoption of open source software
- The importance of starting with a profound insight into the community and development processes for open source
- The value of explicit political goals
- Processes for establishing government agency requirements

Widespread enthusiasm for the use of open source software already exists in federal agencies, often invisibly to the public. The movement for open source software enjoyed a publicity boost when the White House launched its recovery.gov Web site on the open source Content Management System called Drupal (Scola, 2009), but countless earlier examples of its use abound, such as Department of Energy's Open Energy Information (OpenEI) platform (Department of Energy, 2010), the Department of Homeland Security's Virtual USA information sharing site (Department of Homeland Security, 2010), and the Veteran Administration's release of its VistA health record system (Veterans Health Administration, 2010).

Yet most departments still lack an understanding of fundamental goals in open source software adoption and a path toward making decisions in keeping with core government responsibilities. Cost savings, the naive enticement, doesn't provide good enough motivation in the end. Although proprietary software (the complement to open source software) tends to come with high licensing fees, whereas open source software can be downloaded without payment, monetary arguments for deploying open source software are usually unsuccessful because the high costs of conversion, retraining, and developing an adequate base for support can postpone the potential savings of open source software for many years.

Experiences both positive and negative show that managers interested in open source must back up their commitment with explicitly political goals, while offering arguments that are more subtle than cost savings and that cite the public interest.

1 Surveys have shown that developers of open source software prefer the term "free software," but because the term "open source" is ubiquitous in the United States federal government, that term will be used in this paper.

Reasons for Adopting Open Source Software in Government

As open source proponents never tire of pointing out (but business and policy decision-makers rarely grasp), the key trait distinguishing open source software from proprietary software is not its availability free of cost, but its provision under a license that allows anyone to alter it and redistribute the altered form. Freedom to change, improve, and extend the software—that is the trait that draws a hard and fast line between software that can be defined as open source and software that remains locked in to a particular developer. Revealing source code to a particular customer or even to the general public is not enough to define a product as open source; it must also have a license that allows unlimited changes and redistribution by anyone.

The advantages this trait of open source software offers are well cataloged—the ability to continue support and development if the original developer goes out of business,[2] the ability to extend it in ways that the original developer does not find worth its while, the community involvement in finding and fixing bugs quickly, and other advantages—but governments are mandated with several responsibilities that make open source software particularly necessary:

1. Access for all

   If sharing documents or interacting with an agency requires a software purchase, the agency effectively discriminates against some of its constituents on economic or technological grounds.

2. Vendor independence

   To require software from a particular source, whether or not the source charges for it, is a form of unfair favoritism. In addition, dependence on the vendor increases risk in the event that the vendor goes out of business, stops supporting a product, or makes changes that leave documents incompatible with earlier ones.

3. Archiving

   Agencies must preserve many documents for periods measured in decades. A vendor, at its own discretion, can stop supporting a non-open format at any time. Even vendors who commit to supporting their formats can upgrade them in ways that render old documents unmanageable. Large institutions consequently spend large sums to copy documents to new formats (both hardware and software) in a Red Queen's race to simply maintain a consistent level of access to these documents. Many institutions require documents to be put on paper merely for archival reasons, but the paper obviously lacks the digital formats' advantages in searchability and computer processing.

4. Special government needs

2 Open source advocate David López points out that open licenses have permitted Brazil to develop educational content in Portuguese, and Spanish agencies to translate software into languages not supported by vendors, such as Catalonian, Vaskish, and Galician.

Governments have special requirements, notably regarding privacy, that vendors need not respect. This conflict came up recently not with licensed software, but with the federal rush under the Obama Administration to use popular online media and social networks such as YouTube and Twitter. After complaints from privacy activists that the YouTube video service was recording visits in cookies on visitor browsers, YouTube actually created a special viewer for the White House site that lets the visitor view the site without receiving a cookie—but a cookie is still downloaded if the visitor plays the video (Grove, 2009).

5. Security

As shown by the previous item, private firms can insert features into software that may be detrimental to safety or organizational practices. Many private software solutions, for instance, use fragile encryption mechanisms and other poor security features; the users cannot even assess the vulnerabilities without access to the source code, and cannot fix them because they lack the legal right to alter and redistribute the program. Governments have procedures for doing assessments of critical software, but open source software provides a guarantee, unmatched by any closed source software, that users can find and fix security flaws without waiting for the vendor.

One international survey of open source in government (López et al., 2010) divides the reasons for adoption into three categories: strategic, feature-oriented, and cost-oriented. Strategic considerations correspond essentially to the five reasons just listed. Feature-oriented considerations select open source software that works better than proprietary alternatives, or that offers features not found in any proprietary product. Cost-oriented considerations adopt open source to save money. The primacy of strategic considerations will be seen in the examples cited in this article.

The Role of Formal Planning and Organizational Change

The cases cited in this paper demonstrate that new organizational initiatives often spawn an interest in open source:

- A Peruvian law mandating open source sprang from attempts by a software architect to rectify ambiguities and inconsistencies in the application of tax codes (Chan, 2008).

- The U.S. state of Massachusetts reached the decision to allow open source software when required to make a strategic plan for government software use (Updegrove, 2007b).

- The city of Munich opened up an inquiry leading to the adoption of software when it had to face the end-of-life announcement for its Windows software (Schießl, 2009).

The migration to open source, in turn, often reveals structural or policy ambiguities and inconsistencies that require repair.

A recent policy letter from the CIO of the state of California, meant to "[f]ormally establish the use of Open Source Software (OSS) in California state government as an acceptable practice," provides a worthwhile reminder that all agencies considering open source software do so as part of their routine Software Management Plan (State of California, 2010).

The Importance of a Profound Understanding of Open Source

The adoption of open source software is more than a technical matter, or even a policy decision. It imposes new tasks on management and staff alike, requiring a heightened engagement with the software development process:

- Merely learning about the existence of appropriate open source software can be difficult, because most projects lack marketing staff.
- Installation often requires many manual steps and the integration of several different software packages, tasks simplified in the case of proprietary software because vendors provide a turn-key procedure of send staff to the agency site to perform installation.
- Open source software tends to be updated more frequently than proprietary software and may require agency staff to explicitly check for updates, in contrast to proprietary products that roll out official upgrades.
- Open source software provides valuable opportunities to collaborate with the community that builds up around the software, but this requires an understanding of the dynamics of such communities and dedication of agency staff to maintaining a relationship.
- Licensing of open source software, although intended to promote free exchange, embodies restrictions of its own that agencies must understand if they plan to distribute it publicly.

Hence, management and staff must possess an understanding of the open source movements and its communities that goes beyond what they can learn merely by reading about it in the press or talking to advocates.

Political Will

Government agency managers like to think of themselves as rational actors who weigh courses of action objectively. In reality, of course, prejudices and simple inertia dog every decision. Resistance to major changes such as the adoption of open source software can often be blamed on vendors of the products in current use. But before they even face such lobbying,managers and advocates for open source software must recognize and counter resistance that develops naturally within an agency. When all stakeholders inside the agency are firmly committed to a course of action, outside pressures can be more successfully parried.

Joseph Reddix, an entrepreneur with forty-two years of experience both inside and outside government, notes that the major barriers to change are cultural. These include:[3]

- Familiarity with current software.
- Fear of failure, which reduces willingness to undergo risk.
- Lack of knowledge about open source, which requires the kind of direct experience as described in the previous section.
- Concerns about the maturity of software that is newer than the proprietary products in current use, as open source tends to be.

Other issues in government IT are double-edged: they can either retard or motivate the adoption of open source. These issues include:

- Security. Some managers with a poor understanding of open source accept the canard that it is inherently less secure. Those with a stronger understanding realize that they can evaluate its security directly by having knowledgeable staff or outside experts look at the source code and do white box testing.
- Integration. Most software must exchange data with other, existing programs, often in other agencies or with outside partners. When such programs are proprietary and fail to adhere to standards, they impede the adoption of any new solution, whether proprietary or open source. But integration works in favor of open source in departments willing to take on the costs of large-scale migration, because open source solutions can be integrated more readily.

Proponents of open source therefore perform a delicate balancing act. They need to follow formal guidelines by producing objective justifications for a move to open source. But the inner fire that will actually make migration successful has a political basis.

Peru provides a good example. Chan reports the public agitation that saved the Law for the Use of Free Software in Government Agencies, Proposition 1609 (Chan, 2008):

> ...the proponents of Peru's FLOSS bill had to undertake various forms of local and non-local work to advance their interests. Their practices departed from the language of technical and economic rationality that is repeatedly invoked to explain FLOSS' adoption. They insisted instead on a new framing of FLOSS as necessarily engaged with governance and political reform....

3. Personal conversation with Joseph Reddix.

> ...the bill was not motivated by economic rationales but by the state's "fundamental" political obligation to citizens. These [sic] included ensuring citizens free access to public information and ensuring the permanence of public data.

The bill favored the use of open source in public agencies, stating the explicitly political justification of eliminating Peru's dependence on foreign software. A later letter from congressman Villanueva, the bill's sponsor, added to its goals (Greene, 2002):

- Free access to public information by the citizen
- Permanence of public data
- Security of the State and citizens

Even more insistent political goals drove the civil society support for the bill (Chan, 2004): the demands for open formats and protection of data as a way to secure the rights of citizens vis-a-vis their own government. It was the General Manager of Microsoft Peru, in opposing the bill, who called for decisions to be made on consideration of technical requirements alone.

It cannot be overstated how important the public mobilization in defense of the Law for the Use of Free Software in Government Agencies—a mobilization that had overt political goals and took on an international character—was for the ultimate passage of the bill. Proponents helped Villanueva fashion his responses to critics and created a groundswell of public opinion in favor of the originally obscure measure.

Other governments have also mandated the use of open source software on the grounds of principle. An official announcement in Venezuela came straight from the President, Hugo Chávez, in 2004 (Wilpert, 2004). Although proponents cite cost savings and (in many cases) the higher quality of open source software, the most effective and enduring reasons for adoption are the non-negotiable government responsibilities cited in the previous section.

Such high-level support for open source can improve the general atmosphere for discussing its adoption, but to make it happen, the management of particular agencies must be firmly committed to it—and must understand the efforts needed to fulfill the commitment. No pronouncement by Hugo Chávez in Venezuela or Vivek Kundra in the U.S. can by itself bring open source into agencies; it is the local management and staff that will install it, resolve interoperability problems, provide training, and interact with the community surrounding the software.

Open Source and Open Government

The kind of fundamental dedication to change described in the previous section reaches its clearest expression in the movement known as open, transparent, or participatory government. This movement has been growing rapidly for the past several years. The best-known example comes from the most powerful body in the world, the U.S. Federal

Government, where President Obama released a Memorandum on Transparency and Open Government on his first day in office (Obama, 2009). On December 8, 2009, the Office of Management and Budget pressed on with the initiative, issuing a directive to executive departments and agencies with steps to take toward openness (Orszag, 2009).

The open government movement tends to release information in digital form and to exchange digital information over the Internet to draw on public input to government decisions and projects. The new forms of public participation in government spread across a broad range of activities. A few examples include:

- Expansion of the conventional "notice and comment" period for government regulations

- Crowdsourcing, or requesting information about living conditions directly from ordinary citizens "on the ground" at a much lower cost and with much more accuracy than the agency could achieve by assigning staff to the task

- Public monitoring to avoid fraud and waste, exemplified by the IT Dashboard (Federal IT Dashboard, 2010) tracking federal IT project progress and expenditures, which Vivek Kundra, the first CIO of the U.S. federal government, unveiled shortly after his appointment

- The creation and release of computer programs to collect and upload data from the public or to process mass downloads of data in program-friendly form provided at locations such as the U.S. government agencies' data.gov site (Data.gov, 2010)

These initiatives provide new imperatives for open source software, because the open government movement relies and thrives on access by all and on the transparency of the data and software tools used to implement public interaction. Much of the information exchanged in the open government efforts comes in documents, audio files, or videos, running into the responsibility for access discussed earlier in this paper. Open formats, the topic of a later section, should be a requirement for any outreach to the public.

The Relation of Open Standards to Open Source Software

A standard can be established many ways—there are *de facto* standards as well as *de jure* standards, and the *de jure* standards can be established in a more or less open fashion—but open standards provide the most chance for wide-spread participation for setting the standard and the most opportunity for competitive implementations. Standards that are not completely open make it difficult or even impossible for anyone to provide working alternatives to the implementations currently in use, and any element that hinders competition in this manner is inimical to the impetus to create the standard in the first place.

A trivial but highly relevant example is the licensing that encumbers all popular digital audio and video formats. A open source MP3 player cannot legally be distributed in the United

States and many other countries, because MP3 uses patented techniques whose owners insist on royalties (Thomson, 2010).

Robust and rich-featured standards exist for audio and video and are supported by many players, both proprietary and open source. But the proprietary software and hardware vendors prefer the encumbered formats and promote their use. The general public does not understand the complexity of patents and licensing and are generally shielded from their consequences because companies such as RealNetworks, Inc. (the distributors of RealPlayer), Microsoft, and Apple usually absorb the royalties and offer players for no cost. But unless the vendors choose to offer players for alternative operating systems such as Linux, no legal options exist—and even if players are offered, the encumbrances prevent them from being open source software.

The World Wide Web Consortium, which is led by Tim Berners-Lee and maintains the most basic specifications for the Web (starting with HTML and HTTP) came to a major fork in the road in 2001, when they were pressured to standardize technologies covered by patents and requiring royalties for use. The Consortium tried to create a pathway for royalties using the common language of "reasonable, non-discriminatory royalties or fees" (World Wide Web Consortium, 2001). They were quickly inundated by outcries from the Web developer community, pointing out that once technology requiring royalties became deeply embedded in Web technologies, individual companies could restrict activities on the Web. Royalties imply conditions for use, which in turn imply limitations, and because the way intellectual property limitations operate is that anything not explicitly permitted is forbidden, these limitations will at some point inhibit the rights of users and opportunities to innovate on top of the patented technologies.

The final policy upheld the principles of open standards and required all technologies to be royalty-free (World Wide Web Consortium, 2004). The W3C thus avoided the risk of promoting policies that could fence off key Web technologies. (Given the workings of the patent system, the principle applies only to those who participate in setting the standard—outside parties can still pop up to assert patents and try to exert control over commonly used technologies.)

More troubling is the famous case of the Microsoft Office formats, which went through a standardization process at Ecma (known for standardizing JavaScript, among other computer technologies) and the International Organization for Standardization, one of the world's premier standards institutions. The story made headlines in the mid to late 2000s. A bit of history concerning this standardization process and the attempt of the Commonwealth of Massachusetts to adopt open source software shows why governments must be cautious in endorsing standards.

Open Formats and the Massachusetts Migration Experience

In the mid-2000 decade, Massachusetts hosted what probably remains the most far-reaching attempt in the United States to deploy open source in government. A secretary of finance and the state's Information Technology Division planned and began a massive move from Microsoft Office to OpenOffice.org. The experiment ended only when the state legislature defunded the project without explanation or justification.[4]

To understand how open source got as far as it did, we must start in 2003 when Governor Mitt Romney brought Eric Kriss into government as Secretary of Administration and Finance. Romney, as most Americans remember, is no political Hugo Chávez; rather, he is part of a multi-generation Republican family and holds socially and fiscally conservative values. The key factor was not ideology but information: Kriss came with some technical background in computing, which in turn gave him an appreciation for the achievements made by open source software and its potential in government (Updegrove, 2007b).

Reasons Kriss initially put forward for using open source included:

- Cost savings. The ITD demonstrated that using OpenOffice.org would save money over time. The legislature challenged their claim and even had the state auditor make a special assessment, an almost unheard-of intervention into administrative affairs. The auditor upheld the ITD's evaluation.

- Taking advantage of the high quality of open source software, where pertinent.

- Using open formats to protect access to information by public and by agencies themselves over time.

- Promoting competition and breaking *de facto* monopolies of software vendors in certain state functions.

Until 2003, the government of the Commonwealth of Massachusetts had no policies or standards regarding software procurement. Although a few people in the administration knew of open source, there was no organized movement for it in the government.

The movement toward open source began with the passage of a state law that said nothing about open source and that the legislature could not have imagined would have any impact on open source. The law simply ordered a strategic plan for technology and the adoption of a set of best practices, and set up an IT commission to implement this initiative.

While working on the state technology plan, Secretary Kriss and state CIO Peter Quinn noticed that Microsoft held a patent on aspects of the XML format in its Office 2003 product. They were concerned about ways it might leverage its patent to demand fees or terms that they didn't consider in the public interest. For instance, Microsoft could theoretically charge a fee for every document issued by the state.

Kriss and Quinn met with Microsoft managers, asking them to give up rights to the patent. Microsoft refused, never even explaining why they had obtained the patent.

4. Material in this section that is not accompanied by citations comes from personal conversations between the author and participants, notably former CIO Peter Quinn.

Thus, while we have seen that Kriss was predisposed toward open source already, the patent irritant contributed to his statement in the official Enterprise Technical Resource Model in 2003 that the state would seek to use software and formats conforming to international standards. The model also indicated that open source would be preferred where it met the state's needs.

After a number of CEOs from computer companies, as part of the Massachusetts Software Council, pressured the administration, Kriss and Quinn retreated slightly and said simply that open source would get fair consideration.

In 2005, Kriss and Quinn put the ETRM into effect by determining which employees using desktop computers would migrate to OpenOffice.org. The goal was to use OpenOffice.org wherever feasible.

At that particular time, Excel was superior to OpenOffice.org's corresponding spreadsheet tool, and OpenOffice.org does not support Excel macros. Therefore, finance department staff who created spreadsheets were kept on Excel. A few other departments with similar needs for Microsoft software were given dispensations to keep using it. However, Quinn found that most state are just consumers of data or creators of very simple documents; all they need are a generic office suite and a web browser. Thus, 50,000 office workers in the Massachusetts state government were designated to move to OpenOffice.org.

Public debate arose over the issue of accessibility, particularly for the visually impaired, which Quinn had not considered. Massachusetts did not have an accessibility law, as the federal government does in the famous Section 508 of the 1998 revision of the Rehabilitation Act (IT Accessibility & Workforce Division, 2010).

Microsoft Office did not support accessibility until the community pressured it in the mid-1990s, but currently has that support. Microsoft noted OpenOffice.org's lack of accessibility features and organized representatives for visually impaired to protest the adoption of OpenOffice.org. Quinn admitted he had made a mistake and said OpenOffice.org would not be deployed until it incorporated that support. This incident highlights the importance of understanding open source software thoroughly during the evaluation process.

However, the true barriers to adoption of open source came from special interests and from intenrnal inertia. Lobbyists for commercial software vendors prevailed on the legislature at every juncture. The conservatism of government agencies described earlier in this paper also came into play.

The Battle Over Standards

Initiatives such as the one in Massachusetts to adopt ODF were launched in many U.S. states but ultimately defeated after sustained lobbying by Microsoft (Lai, 2007). One result of the budget cuts and political fighting in Massachusetts was the departure from government of the original backers of OpenOffice.org migration, a vacuum that set up a reversal of its principled demand for an open format.

As the Massachusetts administration was formulating its policy on open formats, Microsoft at first fought and failed to get the administration to accept Microsoft Office formats in the initiative (Berlind, 2005), then developed Office Open XML (OOXML), an XML implementation of its Office formats, and presented it to several government bodies as well as to Ecma and ISO for approval.

Critics of the Microsoft bid raised numerous grounds on which the Microsoft Office formats do not constitute a standard (ODF Alliance, 2008; Groklaw, 2010). Even topping 6,000 pages, the Microsoft specification for what they called OOXML did not fully specify the behavior of their office suite and could not serve as the basis for an alternative implementation. Even Microsoft Word in its different versions are incompatible. For instance, documents created with the current Windows version might not display properly on the current Macintosh version, or change tracking might cause corruption when documents are exchanged.

OOXML passed through Ecma quickly. This credential, giving Microsoft a claim to credibility in the standards space, played into an announcement by Massachusetts' IT division in 2007 that OOXML was acceptable along with ODF as an open format (Johnston, 2007). In practice, of course, this announcement represented an acceptance of the status quo and an admission that the state would not switch any systems to ODF or OpenOffice.org.

Given the funding cutoff, the IT department had no recourse except to stick with Microsoft Office, but along with Ecma, they helped to blur the definition of an open standard. If practical necessities require a government agency to set aside its commitment to archival security, open access, and related responsibilities, this should be stated candidly. Abatements can be changed later when financial or technical improvements make it possible to use open standards. But to declare something open when it is not does more than sow distrust—it pollutes future debate and perpetuates public ignorance. Furthermore, agencies should not accept uncritically a moniker of "openness" from other institutions, even highly regarded ones such as Ecma and ISO, when these institutions take a lax attitude toward the traits held important in the open source movement.

ISO also turned down OOXML at first, one of the grounds being that it duplicated the functionality of the already adopted ODF standard. The debate led to an unprecedented politicization of ISO, as numerous members took advantage of loose membership rules to join at the last minute and vote on the issue, usually taking Microsoft's side (Updegrove, 2007a). The administration of ISO also seemed determined to give Microsoft what it wanted, and managed to reverse the vote six months later, amid widespread accusations of arm-twisting and despite several appeals (Jones, 2008).

The purpose of this abbreviated history of the OOXML standard has not been to denigrate the use of Microsoft Office. Millions of office workers and ordinary computer users around the world depend on Office, and the creation of OOXML was a boon to developers who can use widespread XML tools to manipulate Office documents. Competition with ODF did in fact make Microsoft more open—though not in the rigorous sense described in the previous section—and create, in the end, more opportunities for Office users.

We can thus congratulate the open source software community for promoting competition—and Microsoft for improving its product in response—while holding aloft the ultimate goal of a truly open format, just as we can congratulate government agencies who have threatened to adopt ODF and have used that tactic as leverage to win lower license fees from Microsoft, but hope that the agencies reconsider ODF in the future.

What then constitutes an open standard? A good definition is fairly complex. One excellent example was developed by a European Union task force called Interoperable Delivery of European eGovernment Services (Final European Interoperability Framework, 2004). In addition to various common-sense prerequisites and an insistence that patented technologies be available on a royalty-free basis, version 1.0 of the document calls for the standard to be maintained by a not-for-profit organization open to all parties. This is not an iron-clad guarantee of openness, because an open body can be captured by biased leaders and its membership can be manipulated. But at least the definition precludes a vendor from simply declaring its product a standard. It is now the responsibility of IDABC to maintain the uncompromising clarity of this definition, and not to contribute to the same dilution of language and the public interest that can be laid at the feet of Ecma, ISO, and the state of Massachusetts.

Processes for Establishing Government Agency Requirements

The last section of this article offers some models and points to resources for government agencies committed to fulfilling the fundamental public responsibilities listed in the first section.

What the Department of Defense Can Teach: Stakeholder Engagement

The Department of Defense, generally considered a conservative and cautious institution, has sought out open source software for its reliability for many years. A recent memo from the CIO's office states (Wennergren, 2009):

To effectively achieve its missions, the Department of Defense must develop and update its software-based capabilities faster than ever, to anticipate new threats and respond to continuously changing requirements. The use of Open Source Software (OSS) can provide advantages in this regard.

The Defense Information Systems Agency (DISA), the government's largest software development group and IT department, exemplifies a Department of Defense culture of innovation. One of its best examples is the Forge.mil development site, where vendors collaborate to produce software, some restricted to DoD use and some freely downloadable as open source. (Forge.mil, 2010) The project benefited from several forward-thinking decisions:

- Management did not cut off the original proprietary vendors, but required them to work within the new paradigm. This allowed organizational knowledge to be transferred smoothly to new, open source participants. Such a decision is probably easier for the DoD to enforce than smaller agencies, admittedly.

- DISA worked with a respected and highly experienced company, CollabNet, to set up an Agile software development environment. CollabNet specializes in combining the efforts of multiple independent developers (CollabNet, 2010a).

- Management brought major stakeholders in early, both people inside the DoD who were needed to carry through the implementation, and outside vendors. Everyone made a commitment and was given tasks to do. This collaboration allowed them to learn each other's issues and abilities as they went along.

- Management ensured security on Forge.mil.

DISA required only 180 days to set up the first component of Forge.mil (SoftwareForge), an unheard of achievement in government. This engendered trust in the system and kept stakeholders engaged. Guy Martin of CollabNet, the award-winning lead community manager for Forge.mil (CollabNet, 2010b), has described their work as a model for the Obama administration's goals in transparency and open data (Martin, 2009).

What Munich Can Teach: Goal Analysis and Determination to Succeed

One fine model for open source planning is provided by a European Research project called "Consortium for studying, evaluating, and supporting the introduction of Open Source software and Open Data Standards in the Public Administration" (COSPA, 2005). (In Europe, the term "public administration" is generally used for an institution that in the United States is called a "government agency.”) COSPA starts by asking not what kinds of software an agency needs, but what core computing activities or business processes it performs.

The emphasis on business processes is crucial to undercut historical assumptions that limit the possibilities for future evolution. As a trivial example, consider asking an agency IT manager what software they need for document creation and exchange. The IT manager might reasonably respond, "We need software to create and edit PDF files," because they currently exchange and release a lot of documents in that format. This kind of assessment locks the agency into historic practice, and probably into a proprietary product. But what is a PDF after all? A format designed specifically to produce printed pages. As documents are exchanged and collaboratively written online, PDFs become less and less relevant.

PDFs are particularly inappropriate for much of the information released by initiatives in open government. These initiatives tend to involve large data sets appropriate for searching, filtering, and automated processing. For instance, people who visit an agency's Web site for crime statistics might want to compare the number of crimes reported in different counties or city districts. Governments typically release this information in tabular form in a Word or

PDF file, making it extremely hard to extract in a form amenable to searching and statistical analysis.

In the COSPA framework,[5] a better starting point for discussion is the question, "How do you create, exchange, and review information?" The IT manager would list the kinds of information each department works with and the types of work done by employees with that information. It may then emerge that the department's needs are best met by a wiki, an online service such as Google Docs, or some other system focused on storing and exchanging documents online.

Such a conclusion still leaves several tasks to the agency. It must determine whether it can afford a move to more appropriate formats and software packages, and must develop a transitional program such as the one created by the Massachusetts IT division.

One valuable historical precedent for this task is the assessment of costs and benefits done for the city of Munich in Germany (UNILOG Integrata et al., 2003). Tellingly, the city adopted Linux even though the assessment showed that the transition would cost more than an upgrade to new Microsoft products. Conversion costs would, in the time frame feasible for financial planning, exceed Microsoft licensing fees, especially given aggressive cuts in pricing that Microsoft offered to maintain its contract (Best, 2004).

Like other projects described in this article, the Munich decision was the culmination of a more general inquiry—in this case, the need to replace Windows NT 4, whose end-of-life had been declared by Microsoft. City regulations required the staff to consider alternatives to a simple Windows upgrade (Schießl, 2009).

The Munich experience provides a lesson to other government bodies in determining their true values and requirements. Their research balanced a "Cost-effectiveness analysis" against a "Qualitative-strategic analysis" that reflects some of the responsibilities in the first section of this article, along with other strategic considerations such as employee satisfaction and the ability to work with other organizations. (As the IDABC document illustrates, inter-agency cooperation is a key motivator for re-examining software use in European governments.)

A staff person coordinating the migration therefore defends the pragmatism of the decision: "it's not a kamikaze mission by some crazy free software enthusiasts." (Schießl, 2009) Nevertheless, the decision ultimately was based on political considerations, specified in one document (Schießl, 2010b) as:

- Independence and increased flexibility for decisions about software and architecture
- Sensible and sustainable use of taxes
- Strengthening of Munich as an IT location

5 COSPA's process is echoed in the recommendations “WiBe-Framework - WiBe 4.1 methodology: Economic Efficiency Assessment in Federal Administrations (in particular with regard to the use of ICT and eGovernment),” WiBe, *http://www.eu.wibe.de/wibe_framework/wibe_framework.html*, retrieved March 31, 2010.

Another statement of the city's goals was (Schießl, 2010a):

- Freedom of choice: increased independence from software vendors, consultants, platforms, and timelines
- More competition in the software market: increased equality of opportunities for the SMEs to participate in the market
- Cost reduction in the mid term: more options for deciding about costs

One of the key considerations I mentioned earlier that can impede the adoption of open source, the difficulties of interoperability, became very evident in Munich. Schießl reports that Munich started the migration with the following environment: "More than 300 apps, many of them redundant...21 different Windows clients, different patch levels, different security concepts." (Schießl, 2010c). Taking control of this gangly IT creature took precedence over the migration itself.

The IT staff wisely allowed five years for migration. Three years were devoted to setup, customizing, and prototyping. This period included setting standards, determining migration paths, identifying the potential for consolidation, and building knowledge. Two more years were allocated for migration to OpenOffice.org, followed by rollout of Linux on all desktops. This period included training and quality assurance. It was necessary to expand technical support and put it on a firmer footing by such means as formalizing expertise and creating self-paced training materials. For a substantial period—all during the migration—Microsoft Office was still the standard. (Schießl, 2010d)

As of December 2009, the migration effort had accomplished the following:

- All 15,000 workplaces use free software (presumably OpenOffice.org)
- Open Document Format is the standard for exchange
- All employees are trained to use OpenOffice.org
- 2,500 workplaces use the Debian GNU/Linux operating system

Coordinated efforts to share best practices around open source software in Europe have led to an Open Source Observatory and Repository for European public administrations, which describes itself as “a platform for exchanging information, experiences and FLOSS-based code for use in public administrations” (OSOR, 2010). Two other European projects using robust analytical frameworks include Eurostat's data interoperability project (Bierhals, 2009) and an open source migration project by Finland's Ministry of Justice (OSOR, 2008).

An analytical framework allowed these agencies to determine what was really important to them, and to balance financial against non-financial goals. If agencies adopt the course followed by Munich—a robust methodology for determining their software requirements combined with the political will to carry through migration in the face of multiple barriers—

the path to open source can be taken by government agencies in the United States and around the world.

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The Status of Free/Open Source Software among Local Governments: Lessons from Three German Cities

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Abstract

This paper examines the adoption and implementation of Free/Open Source Software (FOSS) by local governments in the United States and considers lessons from three German cities that are at the forefront of FOSS adoption. Research on FOSS in the public sector finds that American cities could experience cost savings, intergovernmental cooperation, independence from monopolistic software providers, increased flexibility, innovation and security, and local economic development benefits from adopting FOSS (Simon 2005; DiBona et. al 2006; Enav 2003). Despite these potential benefits, and despite high levels of satisfaction in the case study cities, American cities surveyed have been slow to adopt FOSS. The study explores ways to increase adoption of FOSS in the US and makes suggestions to ease the transition, based on the German cities' experiences.

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Introduction

This article examines the adoption and implementation of Free/Open Source Software (FOSS) among local governments by considering the experiences of three German cities at the forefront of FOSS adoption. Research on FOSS in the public sector finds that the 60,000 localities in the United States could experience cost savings (Titterton, 2003; Enav, 2003), intergovernmental cooperation (Gehring, 2006; Weber, 2004), independence from monopolistic software providers (Waring & Maddocks 2005), increased flexibility (Krishnamurthy 2003), innovation and security (Carnall 2000; Rapoza 2002), and local economic development benefits from adopting FOSS (Simon 2005; DiBona *et. al* 2006; Enav 2003). Despite these potential benefits, and despite high levels of satisfaction in the case study cities, American cities have been slow to adopt FOSS. A survey of medium-sized local governments throughout the US found that 40 percent report using some form of FOSS application (Ward & Tao, 2009). A recent survey conducted by Kent State University's Center for Public Administration and Policy found that of the 428 local governments in northeast Ohio, only 15 percent of governments who responded to the survey reported using some FOSS application. Preliminary findings from the northeast Ohio survey appear in a forthcoming chapter by Cassell and Hoornbeek (2010).

At the heart of this study is the following question: If local elected officials or information technology (IT) administrators are interested in migrating to FOSS, what should they keep in mind when deciding whether and how to make the technological transition? The question is addressed by comparing the experiences of three local governments in the Federal Republic of Germany, all of which adopted a policy nearly a decade ago to migrate their entire IT systems (including desktop operating systems) from proprietary systems to FOSS. The focus here is on the adoption of FOSS operating systems and desktop applications as opposed to backend infrastructure such as servers. The three cities – Treuchtlingen, Schwäbisch Hall, and Munich – represent the most advanced migration to FOSS among local governments in the world. Table 1 provides background on each city in the study including their size and a selected list of FOSS applications used by each city. The cities vary in size from a population of 13,000 in Treuchtlingen to 1.3 million in Munich. The local governments also vary in the degree to which they have implemented their migration policy; Treuchtlingen and Schwäbisch Hall have completed migration but Munich's migration is only partially complete. And while each city followed its own path toward FOSS, they overcame a similar organizational and personnel challenges that shed light on what local governments in the United States should take into account as they consider a similar policy.

Germany and the United States obviously differ in a number of important ways that may illicit skepticism about the benefits of such a cross-national comparison. However, the two countries share a federalist system that cedes considerable fiscal, political and administrative responsibility to local governments (Gunlicks 2008; Conradt 2009; Derlien 1996). Home Rule in the United States and the German constitutional provision known as *Kommunale Selbstverwaltung* ("city and county self-administration") means that local governments in both countries are administratively independent of other governments and, more importantly, are on their own when it comes to e-government. Pressure to modernize, intergovernmental competition, lack of IT expertise, and lack of funding are challenges cities and counties in both countries confront. Moreover, the federal system in both countries ensures that local governments have a similar set of tools to address their IT needs. Thus, notwithstanding significant differences between Germany and the United States, the experiences of three German cities offer potential insights for their American counterparts.

The following outline is used to present the research. Following this introduction a second section reviews what we know about the challenges local government face in adopting and implementing FOSS. An account of the methodology and design of the case studies is offered in a third section. The fourth section reports the results of the case studies along with some concluding remarkets.

Table 1: Cities in the study

City	Population	Interviews	Selected FOSS applications in each city
Treuchtlingen	13000	2 IT administrators 1 elected official	Sun Enterprise 450 Server. Sun Ray 1 Clients KDE Desktop SMB (Server Message Block) MySqul Star Office Suite
Schwäbisch Hall	36,000	1 IT administrator 1 elected official	SuSE Linux Enterprise Server 10/11 CentOS Debian SuSE Linux Enterprise Desktop 10 Ubuntu 9.10 OpenOffice Suite Gimp Document Imaging System Firefox MySQL
Munich	1.3 million	2 IT administrators 2 elected officials	Debian GNU/Linux OpenOffice Suite KDE 3.5 and Xorg Mozilla Thunderbird Firefox

FOSS and Local Governments

What is FOSS?

FOSS is a generic term for software that is non-proprietary, can be reviewed by large numbers of users, and can be revised and shared free of charge. FOSS differs from software in the public domain such as Transmission Control Protocol/Internet Protocol (TCP/IP) that allows networked computers to connect to each other. Instead FOSS describes software that imposes legal conditions on users through licensing. Specifically, FOSS are programs whose licenses permit users the freedom to run the program for any purpose, to study and modify the program, and to freely redistribute copies of the original or modified program. A discussion of specific types of FOSS licenses, how they have evolved, and the distinction between "free software" and "open source software" can be found elsewhere (www.fsf.org/philosophy/free-software-for-freedom.html).

The use of FOSS is widespread in the public and private sector. A recent survey of 328 IT and business executives found that 53 percent use FOSS software and an additional 10 percent planned to use FOSS in the next 12 months (Schindler 2008, 46-47). A 2007 survey of 113 million websites by Netcraft finds that Apache, a FOSS web server, is the most widely-used web server with 58 percent of the market share (Netcraft 2007). The FOSS web browser, Firefox, continues to gain market share on Microsoft's Internet Explorer, particularly among users who have a choice of browser. Large portions of the US government including the National Security Agency, the Defense Department, and the Department of Energy also use FOSS to some degree (Weber, 2004; Schearer 2008; Wheeler 2007). Further, 65 percent of all active websites use open source code to run their sites.

Local governments as diverse as Largo, Florida and Paris, France have opted to migrate at least some of their cities' computer operating systems and software applications to FOSS. The survey by Ward and Tao (2009) found that 39.6 percent of US cities use some form of FOSS. There is currently no accurate survey of how many local governments have turned to FOSS. However, anecdotal evidence suggests that a growing number of local governments are considering, and even adopting and mandating policies to migrate from proprietary software to FOSS alternatives. Yet studies of the role of FOSS within US local governments are rare. This is surprising in light of the significant attention devoted to the topic of e-government in local governments by public administration and management scholars. FOSS, I suggest, should be understood as a fundamental part of e-government because, at its core, adoption and implementation of FOSS is about how local governments manage, use and control their technological infrastructure.

What Factors Influence Adoption and Implementation of FOSS by Local Governments?

For governments, the major challenge in migration to FOSS is found at the intersection of desktop operating systems and software applications. An operating system is the software that manages the resources of the computer. It serves as the platform on which word processing, spreadsheet and other applications run. The most commonly used operating system is Microsoft Windows. But there are others including Linux and Mac OS X. Applications, on the other hand, are computer programs designed for the end user such as Microsoft Word, Turbo-Tax or Eudora. Applications run on the operating system. Most governments (like most firms) already use some form of FOSS to manage computer networks. But the decision to switch to FOSS operating systems such as Linux is wrought with challenges. There are technical issues of compatibility and interoperability since many popular applications are designed for the proprietary software operating systems, Windows and Mac OS (Waring & Maddox 2005; Holck, Larsen, & Pedersen 2005).

And as with any new IT application or system, there are significant personnel challenges associated with training, accepting, and adjusting to new systems and different ways of doing things (Davis 1989; Gallego et al. 2008). Ward and Tao's (2009) study of local governments' adoption of FOSS argues that migration is a function of the level of knowledge and understanding of open source technologies and their alternatives. Ward and Tao's research fits within a broader literature on innovation that suggests that public sector leaders are important for innovation to occur (Borins, 2008; Yapp 2005). Others note that public employees on the frontline must accept the new technologies (Davis 2008) and that employees must see evidence that the new technology adds value before they accept its adoption.

Organizational factors also affect adoption and implementation of FOSS. Ward and Tao (2009), for example, note that migration to FOSS is a technology transformation problem. The challenge, they argue, is less technological than developing an organizational culture willing to change. They write, "An organization with a culture that embraces change will be more successful at adopting new technologies than an organization with a strong status quo" (Ward and Tao 2009, 2).

Cost is another factor that influences implementation and adoption. Cost-savings is the primary factor that motivates local public administrators to consider FOSS (Titterton 2003). At the same time, scholars point out that migration to FOSS, as with any change in technology, is often costly particularly in the short run. The Free Software Foundation's famous phrase "Free as in 'free speech' not as in 'free beer'," captures the notion that while the license for FOSS is free, there are significant costs associated with writing and cleaning up code, training, purchasing expertise, and maintaining new FOSS-based IT systems.[1] Governments that are financially strapped will find it more difficult to follow a new IT course.

Finally, the research on FOSS and e-government more broadly, suggests there are political challenges to the adoption and implementation of FOSS. Elected officials, particularly in the United States, often express skepticism toward new software particularly non-proprietary software (Seifert 1999). And local governments confront external pressure from software vendors to continue with existing (proprietary) systems. Government IT is an enormous business for software firms and consulting companies. Any change of direction, particularly one that sets government on a new IT path, is likely to be met with opposition and skepticism.

In short, the scholarly literature on FOSS in the public sector suggests that adoption and implementation of FOSS are influenced by a range of factors including: technical feasibility; employee expertise and knowledge of FOSS; organizational adaptability; availability of financial resources; and political support. Before taking a look at three cities that committed themselves to full migration to FOSS, the following section discusses the methodology used to conduct the study.

[1] Free Software Foundation. "The Free Software Definition" Retrieved March 26, 2010.

Research and Methodology

The research draws on three case studies of municipalities that decided nearly a decade ago to fully migrate their cities' IT infrastructure from proprietary software to FOSS. The cities include Munich, Schwäbisch Hall, and Treuchtlingen. They range in size, organizational structure and complexity. All are in the southwest region of Germany. Each city had previously used a version of Microsoft Windows. Each city adopted a policy that committed the municipal government to migrate to the Linux operating system along with FOSS applications.

The case studies were originally conducted in 2006.[2] During a two-month period in May and June 2006, I visited these cities, researched their stories, and interviewed leaders responsible for adopting and implementing the changes. I conducted semi-structured interviews in German and translated them into English. The interview instrument consisted of a set of identical questions related to motivation, implementation, and results. Each questionnaire also contained a set of questions specific to the position of the interviewee (see Appendix A). A breakdown of who was interviewed (elected official/IT administrator) is presented in Table 1. To facilitate coding and analysis of the interviews I used N-Vivo, a qualitative analysis software program. In October 2007, I followed up with each of the interviewees and asked for an update on implementation, and any outcomes or outputs that had resulted from their migration decision. I also relied on internal reports, audits and news releases published by each city to develop the necessary background for the research and to substantiate information collected through interviews. In January 2010, I conducted a series of follow-up interviews with IT managers in each of the three cities to get an update on the status of the migration and ask about lessons they might offer for American officials or IT administrators considering FOSS (See Appendix B).

While illustrative of FOSS adoption, it is important to note that the cases were selected on the dependent variable (adoption), not on variations of independent variables, since there are no cases of non-adoption or failed adoption efforts. As a result, the research is exploratory rather than explanatory. The case study approach is appropriate since the research seeks to understand complex social phenomena – in this case adoption and implementation of FOSS (Yin 2003). The case studies should be understood as complements to the large-N work by Ward and Tao (2009).

Lessions from Germany: Three Case Studies

This results section is presented in two parts. The first part offers a summary narrative of each city's decision to migrate to Linux. The summaries are based largely on newspaper accounts, press releases, other scholarship, and government reports. Part two reports results from the semi-structured interviews.

[2] Results from the original case studies were published previously (Cassell 2008, 2009).

Three Narratives

Schwäbisch Hall.

Schwäbisch Hall is a medium-sized picturesque city located in the federal state of Baden-Würtemberg not far from Stuttgart. Approximately 36,000 residents live in the city, and the city government consists of 225 networked workplaces (Bräuner 2005, 37; Nagler 2005). When it announced its decision to migrate all its servers and desktops to Linux and FOSS in 2001, it became the first city in Germany to adopt such a policy. Two external factors are important for understanding the context of such a policy innovation. First, in 2001 Schwäbisch Hall's support contract with Microsoft was running out, and there was uncertainty about whether Microsoft would continue to support the older operating system or whether the city would be compelled to upgrade. Second, at the point the city was required to make a decision about which operating system it would use, local tax revenues experienced a sharp decline. The drop was felt by all local governments in Germany and was triggered by changes in federal law. A final internal contextual factor is also relevant: Schwäbisch Hall had been using FOSS to run its administrative servers since 1997, and therefore the city's IT staff was familiar with it. In response to the two externally-imposed constraints, the city's IT department launched "Linux im Rathaus" ("Linux in the City Hall") in 2001. By December 2001, Schwäbisch Hall, with the help of two companies, Suse/Novell and IBM, had put in place a plan to migrate the city's servers[3] and desktops to FOSS. Migration began in 2003 and was completed by the end of 2004. The migration of servers covering administration, email, printers, files, and group calendars occurred incrementally. The migration of software used by employees at their workplaces occurred simultaneously with introduction of Open Office groupware. The IT department was able to locate most software application alternatives that could be used under Linux. In those select cases where a required application could only be run in a Windows environment, the IT department kept a Microsoft-Terminal server.[4]

During the migration period there was some opposition among city personnel. To reduce anxieties, the IT department employed two approaches. First, it proactively engaged the public-sector labor union and consulted with union leaders about the migration. A female union leader gave the first demonstration of the new FOSS systems to a large gathering of city employees. This had the two-fold effect of showing union support for the migration and demonstrating to a somewhat sexist audience that a woman was comfortable with the new technology. A second strategy employed by the IT department to reduce concerns was to encourage employees to take the new software home and install the systems on their home computers. Since there was no licensing fee, the city could encourage home use without any additional cost. This both showed the value of the IT innovation and helped personnel feel comfortable with the changes.

It has now been ten years since the migration was completed. The central administration and all technical departments use open source based systems. Schwäbisch Hall has also

[3] A server is simply a computer program that provides services to other computer programs. A server typically fulfills requests from other computer programs like printing a document or downloading a webpage.
[4] A terminal-server is a program that provides terminals (PCs, printers, and other devices) with a common connection point to a local or wide area network.

developed a number of FOSS applications to enable its government to operate more effectively including software to support the work of parliamentarians, a program to archive documents, and a document management system. Each of these innovations was done under a GNU General Public License (GPL), which not only enables Schwäbisch Hall to share its innovation freely with other governments but also requires that new users of the innovation agree that if a modified versions of the code is redistributed, it is done under similar license terms. The city is also consulting with smaller governments in its surrounding area; providing technical support and sharing FOSS innovations.

Treuchtlingen.

Like Schwäbisch Hall, the city of Treuchtlingen is a small quaint community with a population of 13,000, located in southern Germany between Nürnberg and Augsburg. The local government employs approximately 400 people working in traditional areas of finance and planning as well as non-traditional areas such as administering a hospital and a large thermal bath center. The city decided to migrate all desktops and servers to FOSS in 2001. At the time the city was using 25 desktop computers running Windows NT and using a variety of proprietary applications. Treuchtlingen's servers used Novel/Linux.

Like Schwäbisch Hall, Treuchtlingen suffered a drop in tax revenues as a result of federal reform of the tax system. The IT department (consisting of two people) and all other departments were asked to cut their budgets. Unlike Schwäbisch Hall, however, Treuchtlingen was not forced to switch because of an imminent loss of technical support from Microsoft. Instead there was an internal impetus to rationalize the city's entire IT system in order to standardize operating systems and software applications. In 2001 workplace computers suffered from a lack of compatibility. An ad-hoc approach to IT had led to employment of different versions of the Windows operating system, word processing software, and other applications. The result was that documents produced by employees within the same office could not be easily shared. The drive to centralize and rationalize the city's IT system thus motivated the IT director to innovate and migrate all servers, operating systems, and software to FOSS. After the IT department tested the FOSS options, they consulted with city staff in selecting which operating system and applications should be used. The aim was to increase compatibility, reduce support costs, and centralize the system. To facilitate centralization, Treuchtlingen took a more radical step than just migrating to FOSS. The city also replaced all its clients or desktops with Sun-Ray Thin Clients, which allow end users to access all their documents and applications from a server rather than from a single individual computer.

In 2010, Treuchtlingen remains highly satisfied with its decision to switch from proprietary to FOSS. Not only has the migration saved the city money, it has made the city less dependent on proprietary software, and it has stimulated innovation in the city. Like Schwabisch Hall, Treuchtlingen has created a number of software applications on its own including an application that calculates labor time on specific city projects.

Munich.[5]

Few governments have received as much attention regarding migration to FOSS as Munich, the capital of Bavaria and, with 1.3 million residents, one of the largest cities in the world to commit itself fully to migrating to FOSS.

The process of migration is ongoing and has occurred in phases. The first phase began in 2001 after Schwäbisch Hall's decision to migrate. Gerd Bauman, a city council leader (*Stadtrat*) and member of the ruling Social Democratic Party (SPD), requested city officials to conduct a study of the costs and benefits of the various software options available to the city. The city contracted to have the study done by a private consultant. At the time, the city had 14,000 desktop computers with approximately 16,000 users. All of the client computers used Windows NT 4 for their operating systems and Microsoft Office 97/2000 for their word processing applications. The server software used Novell Netware, an open source product.

A year later, in 2002, the study was released comparing the costs and benefits of five alternative configurations, matching different operating systems with various office products. In addition to costs and benefits, the study also included in its assessment the technical feasibility and strategic long-term effects of each configuration.

During this period of assessment, Munich's IT plans had largely gone unnoticed by the press and the general population. That changed, however, when Steve Ballmer, Chief Executive of Microsoft, broke off his ski vacation in the Alps to pay a personal visit to Christian Ude, Munich's mayor. Ballmer's visit – designed to offer Munich a better bid and negotiate a deal for Microsoft – had the opposite effect. First, it led the other companies in the bidding process (IBM and Novell/Suse) to improve their bids. And more importantly, Ballmer's visit reaffirmed a stereotype many Germans hold of the American business executive ignoring local rules and tradition in order to get a deal done. The SPD party in the city council was particularly incensed by what it perceived as the arrogance of Ballmer to assume he could avoid the council and discuss a deal directly with the mayor. In May 2003 the council passed a resolution committing the city to migrate its operating systems and software applications to FOSS.

At the time of its decision Munich was also struggling with the dual external pressures of falling tax revenues and the imminent loss of technical support for its Windows NT operating system. Like Schwäbisch Hall, Munich was in a position where it was forced to make a choice to upgrade or change to FOSS.

The migration process in Munich has been considerably slower than for Treuchtlingen and Schwäbisch Hall. Following the council's resolution, 18 months elapsed as the city developed, with assistance from IBM and Novell/SuSe, a prototype for the new system software and a plan for implementing the policy. In this detailed plan, the city first took stock of what types of software applications were being used, the availability of FOSS alternatives,

[5] Munich has published a significant body of reports on every stage of the migration process. For a recent profile of Munich's progress see the case study by Karsten Gerloff (2008). In addition, Munich has placed a great deal of material about its migration to FOSS on-line. Much of it is in English [see http://www.muenchen.de/Rathaus/dir/limux/english/147197/index.html].

and staff training needs. By the end of 2004, the city had finally established a new IT department charged with implementing the migration policy. Migration began in early 2005. Since then, the migration process has moved forward incrementally. Some city personnel were resistant to the changes. Migration was plagued by legal problems. And, there have been unforeseen technical issues associated with the city's new computerized accounting system developed by SAP.

An additional contextual variable relevant to understanding Munich's migration experience is its organizational structure. The city is organized into 17 departments, each with its own IT personnel. The Linux transition department was the first separate "corporate" IT department ever created. In May 2006, when I did my field research, the first city department was just beginning to roll out the new FOSS software. By November 2007, three of Munich's 17 departments had been converted to Linux. By July 2009 100% of work stations were using Firefox and Thunderbird, 12,000 work stations had switched to OpenOffice.org, 2,000 work stations in four departments had migrated to a version of Linux developed specifically for Munich known as *LiMux*, and all other departments were scheduled to migrate fully by 2011.

In sum, Treuchtlingen, Schwäbisch Hall, and Munich represent the most advanced migration to FOSS among local governments in the world. The following turns to the lessons they offer to American officials and IT personnel considering the switch to FOSS.

Lessons from Three Cities.

IT directors in each of the three cities were each asked the following question: "What suggestions would you give to a manager or IT director in an American city considering the switch to FOSS?" The following summarizes their answers.

*Political backing and leadership are essential***.** The adoption of new technology is difficult under any circumstances, whether proprietary or FOSS. The FOSS literature argues that political backing is an essential ingredient to a successful migration since IT managers need the freedom to take risks. The experience of the three cities confirms this. In each case, the mayor and the parliamentary majority supported the shift to FOSS. As one IT director put it, "The political leadership must embrace the change to FOSS in order to give the IT administrator the freedom to make mistakes and try new things." He added that in the case of FOSS, one should expect criticism from private vendors and some resistance from government employees to the change.

In Munich a high-level member of the administration took a leadership role to shepherd staff through the process. In practice this meant the administrator did several things: made the case for adoption; took the political heat when the migration process hit a glitch, thereby shielding the IT staff; and consistently communicated to the parliament and the public the rationale for the migration, thereby controlling the terms of the debate around FOSS.

*Cost arguments should be secondary***.** Scholars note the importance of cost savings in the motivations of local governments to consider FOSS. The experience of the three German cities supports this view generally. However, the story is more interesting than is often portrayed in the literature. Each of the governments turned to FOSS not when surplus funds became available to try something new and innovative. Instead, FOSS became an option across all three cities at the moment a change in federal government's tax system triggered a sudden budget deficit. The federal change served as a triggering event (Kingdon 2002; Jones and Baumgartner 2005); one that directed the attention of public officials to the need to save money and to be self-sufficient. It was in this new environment, created by the change in federal tax law, that FOSS found fertile ground. A lesson offered by the experiences of the three German cities is that while leadership, knowledge and expertise are important, an unexpected event or crisis is often needed to create an opportunity to redirect organizational attention and behavior in a new direction.

FOSS not free. While a decline in tax revenue created an opportunity to adopt FOSS, each of the IT administrators echoed findings in much of the FOSS literature, namely that adoption and implementation of FOSS is costly. As with any new technology, FOSS requires a significant investment in training, implementation, service and maintenance to succeed.

In addition, the IT administrators acknowledged that it is easy to manipulate the Total Cost of Operation (TCO) of any type of technology. As a result they stressed that while cost savings are important, an IT director needs to make the case for FOSS on other grounds as well, including increased cooperation among governments; greater independence from monopolistic software providers; greater flexibility and security; and increased local economic development. Thus, the two takeaway lessons from the three cities are 1) to be successful, FOSS is likely to be expensive in the short-run; and 2) while cost-savings are important, officials should strive to make the case for FOSS on other grounds.

*Take incremental steps but with an overall strategy***.** IT directors in all three cities said that it was unusual for a municipality to completely switch to FOSS in a single step, particularly if the governments have little experience with FOSS. The directors suggested incremental steps or "soft migration." They recommended beginning with common software applications like the Firefox browser, Thunderbird email program, and the Open Office Suite (an equivalent to Microsoft Office). In Schwäbisch Hall and Treuchtlingen, city employees were given free programs on a single disk and encouraged to install and use the software on their home computers. As mentioned, such steps reduced the anxiety of city employees to the new software. A second step is for the city to develop macros, templates and forms in the Open Document format, and set up pilot desktop stations that run on Linux-based operating system in each department.

While they suggested an incremental approach, the IT directors also stressed the need for an overall strategy. "You have to know where you are going. Incrementalism is fine but there needs to be a clear idea of the end goal. Otherwise you could find yourself going nowhere or in the wrong direction," commented one director.

*Practical experience trumps theory***.** Interviews with IT directors confirm Ward and Tao's view that knowledge of FOSS and its proprietary alternatives is important for migration. However, the directors underscored the importance of experience over theory. Just knowing about FOSS was not enough, they argued. Instead the IT directors suggested that any local government considering migration to FOSS should spend time in a government that uses

FOSS, learn first-hand what they are doing, and collect information from line employees who are using FOSS. One IT director also suggested that local governments consider hiring a college intern with computer science training and no bureaucratic experience. He noted, “It’s important to get someone with the latest technical knowledge. But you also want someone who has not been infected by the ‘bureaucratic virus.’ You want someone who will look at a problem with eyes unencumbered by the bureaucratic culture. A university student is often a good resource.”

Organization matters. Scholars including Ward and Tao note the importance of organizational flexibility for technological innovation, “an organization with a culture that embraces change will be more successful at adopting new technologies than an organization with a strong status quo bias” (Ward and Tao 2009, 2). The experience of the three German cities paints a slightly more subtle and complicated view of the relationship between technological change and organizational structure.

First, none of the IT administrators identified organizational culture as important. Instead they identified organizational structure as important. In many local governments the IT infrastructure is decentralized so that each department has its own IT person. In some cases this may simply be an employee with a particular interest in IT, who became the “go to”-person for matters of technology over time. In other cases, the person or people may be IT professionals, or even IT contractors hired by the department for a specific support task. Officials in the three German cities stressed that a change as fundamental as migrating to FOSS is easiest with a centralized IT department. Based on their experience with migration, the directors reported that a decentralized IT structure creates cultural and structural barriers in the organization that make it difficult to adopt a government-wide strategy.

In Munich, for example, prior to migration to FOSS, IT was highly decentralized. More than 850 IT professionals were scattered across 17 departments. The departments did not resist change per se. Instead, when migration to FOSS was proposed, the city departments were reluctant to give up what they perceived as *their* IT professional(s) or expertise. This significantly slowed the migration process since migrating to FOSS required taking stock of the government’s entire IT infrastructure, identifying FOSS alternatives, and then standardizing the operating systems and software for the entire government. Such a change is made easier by a centralized IT structure, regardless of the organizational culture in the city. IT directors in all three cities argue that a centralized structure improved migration to FOSS.

The three cities’ experience with migration to FOSS also demonstrates a more complex relationship between organization and technological change than what appears in the scholarly literature. While technological change is often viewed as the product of organizational characteristics, the three case studies point to an inverse relationship: new technology changes the organization.

Respondents in each city explained that migrating to FOSS led to virtual and physical organizational changes. Virtual organizational change refers to how the cities managed their computer software systems. The policy to migrate to FOSS forced each city to take stock of its IT hardware and software because without such an assessment it would not have been possible to implement thee migration policy. In some cases cities conducted the assessments on their own. In other cases, cities relied on assistance from private sector partners such as IBM and Novell. As cities addressed their virtual organizations, several also made changes to their physical organizations. In one case, a respondent described the organizational change and its connection to FOSS, "One saw during the process of migrating to Linux how decentralized the IT landscape in our city had become. Something had to change." With the implementation to FOSS, cities took stock of their IT staffs, identified redundancies, and moved the city toward a more centralized IT support structure.

Finally, respondents in the three cities reported that the switch to FOSS improved their internal capacity and increased employees' willingness to innovate. Because the benefits from FOSS derive from being able to work with computer code, the advantages of open source increase as the IT staff's expertise increase. While two of the cities (Schwäbisch Hall and Munich), relied on contractors to assist in the implementation process, all three cities were and are committed to doing as much of the IT work in-house as possible. And, as the skill level of the IT professionals increased, the motivation to innovate also increased. Each city reported developing new programs and applications, which were shared with other cities as well as the broader open source community. Schwäbisch Hall, for example, just developed a new council information application to provide materials and minutes to city parliamentarians.[6] Munich and Treuchtlingen have also developed dozens of new applications. And Munich was recognized with the European E-Learning Award in 2007 for the learning platform the city developed to teach staff how to use the open source software.

Conclusion

Surveys of American local governments done by Ward and Tao and more recently by Kent State University's Center for Public Administration and Policy underscore an enormous opportunity to teach local officials about FOSS. Knowledge and awareness of FOSS remains low among American elected officials and administrators. One model to teach local governments about FOSS in the US is the Linux Solutions Group, an organization based in Stuttgart, Germany.[7] The group is funded by members that include the state government of Baden-Wuertemberg, private firms, universities, and local governments. The group holds conferences, encourages networking and sharing of ideas, and develops software solutions useful to all local governments. The IT directors of the three German cities each independently pointed to the Linux Solutions Group as a model that state or regional governments could employ to create an environment that would foster the adoption of FOSS among local governments.

The three case studies underscore the challenges involved in migrating to FOSS. However, they also offer steps local officials should consider before embarking on migration. The suggestions underscore: the importance of goals besides cost-savings; the need to get politicians and employees to embrace the move to FOSS, the importance of an incremental approach within a broader strategy, and the necessity for centralized IT organization

[6] The website for the new application is in German. Information for downloading the city council application can be found at: http://www.schwaebischhall.de/en/welcome/linux.html.
[7] The Linux Solution Group's website is: http://www.lisog.org/.

implement the policy. Finally, what stands out in these three cases is that while technological change is often a function of organizational characteristics, we should be open to the possibility that FOSS will change the structure and culture of an organization.

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Appendix A

The following semi-structured survey instrument was used to conduct the first round of interviews with elected officials and IT administrators in the three cities. All interviews were conducted in German, transcribed in German, and then translated into English. Slight adjustments to the instrument were made to account for the position (administrator or elected official) and location of the respondent.

I. The Decision

1. You give three reasons for the migration:
    a. more independence from producers; "grosssere Herstellerun abhaengigkeit"
    b. increase the competition in the software markets; "mehr Wettbewerb im software market"
    c. fulfilled the strategic aims of the city. "Strategische Ziele für Muenchen besser erreichbar"

    Could you elaborate on each of these?
2. What groups or actors supported the decision? (ask about each of them)
3. What groups or actors opposed the decision?
4. What was your experience with Windows NT, and was there resentment among yourself and the council at Microsoft's decision not to support NT any longer?
5. Was there one event that convinced lawmakers of the decision?
6. Was there a sense that Munich was showing the rest of Germany what could be done, that it was breaking new ground? (Follow-up) Why was it necessary for the city to be a pathbreaker in this regard?

II. Implementation

7. What are the main risks that you face with the use of Open Source? Was there an understanding at the time of the decision that a certain amount of risk was acceptable? (Follow up) What amount?
8. In the conceptual phase, what factors that made acceptance difficult?
9. Was there a particular model of a city or organization you wanted to emulate?
10. The project's organization seems complicated. Could you explain why it developed in the way it did? How much latitude did the team have?
11. What administrative processes or structures needed to change (if any) in order to use OSS?
12. What role if any did the union or works council play in the transformation?
13. How do you manage the problem applications?

III. Outputs

14. By being one of the first major cities to embark on OSS, you bear a great deal of the cost of innovation. Other communities and cities are learning from your experience. Was there ever any effort to work with other governments in the region to share some of the costs?
15. Have you allowed other governments or agencies access to your code? Is it possible that [city name] might sell its expertise to other cities?
16. One of your stated goals was greater independence from software firms. Given that many firms still do not have non-Microsoft applications, do you feel more independent?
17. Has [city name] increased its administrative capacity by adopting OSS or has it been weakened?
18. Are there any questions you believe I should ask? Have I missed anything important?

Appendix B

The following semi-structured questionnaire was used in follow-up interviews with IT directors in the three German cities. The interviews were conducted over the phone in December 2009. The interviews were conducted in German, and lasted approximately 45 minutes.

1. How has [city name] IT system developed in the past two years?
2. What changes, if any, have occurred since you first adopted FOSS?
3. What do you see as the strengths and weaknesses of FOSS in [city name]?
4. Have you conducted any analysis of the benefits of FOSS?
5. Have you worked with other localities to developed their information technology?
6. What policies can state governments pass to further FOSS in local governments?
7. What lessons do you take from your experience with FOSS?
8. What recommendations would you offer American administrators interested in migration to FOSS?
9. Are there any questions you think I should ask?

Insurgent Expertise:
The Politics of Free/Livre and Open Source Software in Brazil

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Abstract

Under the administration of President Luiz Inácio Lula da Silva, the Brazilian state has advocated the use of Free/Livre and Open Source Software (FLOSS) throughout the public sector. How did FLOSS adoption gain traction as a developmental strategy across a large federal bureaucracy that had embraced information technology policies supporting export-oriented growth and market liberalization during the 1990's? In an historical case study, I argue that the FLOSS agenda emerged as a result of the actions of a network of *insurgent experts* working within elite political, technical, and educational institutions. I trace the history of this mobilization and show how a dedicated network of experts brought about conditions for institutional transformation that contradicted prevailing neoliberal policy proscriptions. The Brazilian FLOSS insurgency offers insights into the means by which a group of elites endeavored to reframe debates about technology-driven economic growth around questions of state-led access to source code and knowledge

Keywords: expertise, free and open source software, technology, Brazil, development, politics

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Introduction[1]

Profound inequalities characterize the global trade in informational or knowledge-based economic goods. Since 2000, $97 of every $100 in revenue from licenses and royalties has gone to an OECD country; whereas less than $0.05 of that same $100 has gone to a country in Latin America or the Caribbean (World Bank, 2008). Influence over the Intellectual Property (IP) laws and governance arrangements applied to these intangible assets also remains grossly concentrated in the Global North (Shadlen et al., 2005). Critics describe a "new enclosure movement" whereby Northern states and multinational corporations have sought to expropriate the global knowledge commons (Evans, 2005). Similarly, they contend that the situation presents obstacles to the use of informational goods to promote sustainable economic growth and improvements to human welfare in low and middle income regions (Benkler, 2006, pp. 308-320).

In search of knowledge-based economic equality, governments, firms, and social movements have pursued a range of strategies (Evans, 1995; Evans, 2005; Kapczynski, 2008; Ó'Riain, 2004; Shadlen, 2004). A growing number of these efforts have turned away from export-oriented strategies and neoliberal intellectual property rights regimes to embrace the emergence of an economy in "non-proprietary" informational goods (Benkler, 2006).2 Brazil has actively pursued this path under the presidency of Luiz Inácio Lula da Silva, advancing a knowledge economy policy agenda built around "commons-based" strategies for industrial and human development.[3] This effort has entailed the widespread promotion of non-proprietary information goods and regulatory reforms across state, national, and multinational levels.

As one of the most contentious and high-profile aspects of the knowledge-based economy agenda, the Lula administration has advocated the use of Free/Livre and Open Source Software (FLOSS) in Brazil's federal bureaucracy and many of its semi-autonomous state firms. However, the emergence of FLOSS adoption initiatives within the Brazilian state

1. The data collected for this paper consisted of open-ended interviews, fieldnotes, and a number of textual sources. While the author does not have the permission to publish audio files or transcripts of the interviews, individuals interested in obtaining access to any specific interviews should contact him by email. All textual sources are listed in the bibliography. Those interested in details on how to obtain copies of any documents that may be obscure or difficult to locate should also email the author.

2. I use the term "regime" here to refer to the bundle of legal and institutional arrangements that govern a given sphere of activity (in this case, intellectual property). A thorough discussion of contemporary intellectual property rights and their application to information technology is beyond the scope of this paper (see Benkler, 2006: 1-35; Samuelson & Davis, 2000). In general, I use the schematic label "non-proprietary" to refer to informational resources that are shared in some non-exclusive manner. In the case of software, this usually entails the release of source code under a "free" or "open" license. For sensitive discussions of these terms see Kelty (2008) and Coleman & Hill (2004).

3. By "commons-based," I refer to models of informational production and exchange rooted in the construction of a "knowledge commons." Several scholars of information technology and FLOSS have applied this idea to make distinctions between the optimal governance arrangements for abundant, non-rival, informational resources versus scarce, rivalrous physical resources (see Benkler, 2006; Evans, 2005).

presents several historical puzzles. During the decade prior to Lula's election, Brazil's IT industry and state IT policies had been dominated by export-oriented, neoliberal development policies designed to support the privatization of knowledge-based goods as well as the growth of multinational firms holdings in the domestic market. In addition, neither Lula nor any of his closest advisors entered office with the intention to advocate for alternatives to proprietary information technology production; and yet within three months of the inauguration they became strong supporters of the most ambitious commons-based development policy in the world. How did such politicized support for commons-based strategies emerge and take root across the notoriously fragmented Brazilian state apparatus? Once in office, how did FLOSS supporters within the Lula administration endeavor to "mobilize the state" and the Information Technology (IT) sector behind their new agenda (Abers and Keck, 2007)? Which policy-making tools and organizational levers made it possible for this agenda to gain traction among state elites?

I address these questions through an historical case study of the rise of the FLOSS agenda and the early years of its implementation. Brazil's federal FLOSS agenda emerged when and how it did as a result of the actions of a network of like-minded elites, who I characterize as *insurgent experts*. Since the late 1990's, this group of technological and political experts has mobilized to promote FLOSS through the Brazilian state. In the process, they capitalized on the institutional structures and organizational capacities of the state and the *Partido dos Trabalhadores* (Worker's Party or *PT*) as well as their own shared history in the country's leftist movements. They also benefited from the broader shift in the global IT industry away from proprietary knowledge and towards "open" technologies. Once in power, these FLOSS advocates sought to implement a variety of projects and initiatives. To do so, they utilized a radical discourse aimed at *re-politicizing* the role of the developmental state in the knowledge-based economy.

It is important to underscore that while the FLOSS advocates identified as members of the PT, the PT party leaders were not the source of these initiatives. Linkages between the FLOSS agenda and the PT's policy programs had to be actively constructed and maintained over time – they were not somehow inherent in either the nature of FLOSS or the political positions of the PT. The FLOSS advocates ability to integrate their agenda into the Lula government resulted from many years of movement building in the urban centers of the south and southwest of the country. The leaders of this movement then used their professional and personal connections to bridge the relatively narrow gap between their own networks and those of the PT party hierarchy. The result was a FLOSS adoption effort that, to many outsiders and international observers, appeared seamlessly integrated into the broader developmental and knowledge-based economy agenda of the Lula government. Nevertheless, both the historical processes and the structure of the relations that led to this integration were in fact much more ad hoc and contingent. Framed as radical responses to the neoliberal technology and development policies, the mobilization for national FLOSS adoption reinforced the leftist, progressive image of Lula and the party. However, the work of the FLOSS advocates was, for some, a frustrated response to what they saw as PT leaders' lack of vision when it came to information technology and post-industrial social change (Branco, 2007; Teza, 2008). Reflecting the interests of both groups, the resulting FLOSS agenda took on a shape broadly consistent with the public image promoted by Lula and the PT as well as with the vision promoted by the FLOSS advocates.[4]

I characterize the mobilization of the FLOSS advocates in Brazil as an example of *insurgent expertise* for two reasons. First, the term reflects the modes of self-representation and self-conception that many of the movement's participants communicated in interviews, publications, and public statements. This sort of self-representation is strategic and idealized in many ways, but it nevertheless forms a real and significant characteristic of this group of FLOSS advocates as well as their efforts to frame their agenda. At the same time, merely proclaiming yourself an anti-neoliberal insurgent does not make it so. Therefore, the second reason I use the term *insurgent expertise* derives from the FLOSS advocates' position as politically-empowered experts utilizing technocratic governance institutions to re-politicize information technology and informational capitalism. This effort to capture and re-fashion state institutions of technocratic development and technology policy in opposition to proprietary information technology production represents a self-conscious reaction against neoliberal development policy agendas, which sought to depoliticize the role of expertise in policy-making (Ferguson, 1994; Fourcade-Gourinchas & Babb, 2002; Woods, 2006). Yet, a number of theoretical and empirical analyses of neoliberal development expertise and governance either do not address the existence of such elite-led efforts at resistance or explicitly argue against their potential (Ferguson, 2006; Harvey, 2005; Li, 2007; Mitchell, 2002). As a result, the primary contribution of this paper to the study of "actually existing neoliberalism" (Ferguson, 2006) consists in an empirical analysis of a recent situation in which counter-hegemonic elites sought to use a neoliberal tool-kit to dismantle a neoliberal policy paradigm.[5] As I discuss later, the case of the FLOSS mobilization in Brazil is neither a unique, nor representative example of *insurgent expertise*, but it is useful for thinking about the phenomenon in broader terms.

The success or failure of the FLOSS mobilization (either as a set of policy programs or intra-state political shifts) remains uncertain and is not the focus of my analysis. Instead, I argue that the Brazilian FLOSS insurgency offers insights into the means by which a group of elites endeavored to re-frame and re-politicize debates about technology-driven economic growth around questions of state-led access to source code and knowledge. I therefore emphasize the conjunction of institutions, ideologies, and rhetorics around which the FLOSS advocates oriented their struggle. My account contrasts with existing analyses of the role of technocratic initiatives which have focused exclusively on the depoliticizing effects of governmental expertise. In addition, the case also illustrates some of the challenges that the FLOSS advocates encountered in their attempt to implement state-led FLOSS adoption as an alternative to the industrial upgrading and development strategy of export-oriented software production that prevailed in the 1990's. In this, the FLOSS mobilization demonstrates how transformations in elite ideologies and networks may underly comparable shifts in developmental and technology policy.

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4. In the words of one the anonymous *JITP* reviewers, “As a result this article addresses both how IT influenced politics (and policy) and how politics influenced IT.”

5. I use the term “elites” here (and elsewhere) somewhat loosely to describe individuals with access to the intellectual, economic, political, and social resources to participate in organizational decision-making, policy creation, and other activities characteristic of many institutional fields of power. In this regard, I draw somewhat haphazardly on Bourdieu (1996).

States, Development, and Insurgent Expertise

The significance of the FLOSS mobilization in Brazil stems from the nature of their political project within the Brazilian state and the position of Brazil within the neoliberal informational economy. Previous sociological research into high-tech developmental policymaking and industrial transformation emphasizes institutional explanations for policy success or failure (Guillén, 2001). Within this paradigm, high-tech industrial transformation is the by-product of ideal-typical institution-building undertaken by elites working within the state bureaucracy (Ó Riain, 2004). The state bureaucracy performs a managerial role *vis a vis* society, striving after desirable institutions and integration into global markets (Evans, 1995). Managed properly, developmental strategies produce "multidimensional conspiracies" that bring economic growth and enhanced well-being for the population (Hirschman, 1977, p. 96).

I extend these arguments by re-introducing a critical dimension to the analysis of developmental state bureaucracy: elite ideology. The politics of FLOSS in Brazil demonstrate how the mechanisms of policy agenda setting are often driven by cultural forces beyond the scope of existing comparative institutional studies. Empirical analysis of these cultural forces and their articulation with the organizational, economic, and regulatory aspects of state bureaucracies complements existing scholarship by explaining how one set of ideas about developmental policy may enjoy greater support than another.

My argument also responds to a growing body of research on the dynamics of hegemony and counter-hegemony in the context of neoliberal globalization. By "neoliberal globalization," I refer to the combination of economic and political processes brought about through the spread of finance capital, service work, free market ideologies, and improved communications and transportation technologies that coincided over the final thirty years of the twentieth century (Harvey, 2005; Robinson, 2004). These changes have provoked a shift in the thinking of scholars and policy-makers about developmental state politics and industrial transformation. The spread of neoliberal ideologies among elites and policy-makers has drawn attention to the role of experts in the practice of governance (Mitchell, 2002). Furthermore, the institutionalization of neoliberal policies has inspired research on diverse forms of counter-hegemonic resistance.

This historical case study lies at the intersection of these debates. The experience of FLOSS politics in Brazil demonstrates how a group of insurgent, counter-hegemonic technology experts attempted to advance a vision of post-neoliberal development in the knowledge economy. Ideologies of the free market played a central role in empowerment of neoliberal policy agendas and the concomitant spread of intellectual property rights laws around the world (Harvey, 2005; Sell, 2003; Woods, 2006). Evans (2000; 2005) has depicted resistance to these efforts as examples of *Counter-hegemonic Globalization*. For Evans, Counter-hegemonic Globalization represents a Polanyian (2001 [1944]) backlash against the tyranny of the free market. As he describes it, this process frequently involves the participation of cultural, political, and economic elites, who can play an important strategic role in the elaboration of alternative governance arrangements and policy projects. The status of these elites and their relationship to hegemony is often complicated by power dynamics the potential for movement co-optation (Thayer, 2010). However, within this literature, few have analyzed the role or position of *technical* elites. The experience of FLOSS in Brazil shows how challenges to the neoliberal *status quo* can arise within elite spheres of power and bring about concrete institutional transformation in alliance with more traditional kinds of social and political movements, such as the PT. Indeed, I show how key FLOSS advocates drew on their experiences, resources, and social networks developed in the powerful Brazilian labor and democracy movements of the 1960's-80's in order to bring a FLOSS agenda into the political mainstream.

What, if anything, differentiates the group of technology-savvy elites involved in the FLOSS mobilization from other networks of technocrats promoting their preferred set of policy interests in Brazil or anywhere else for that matter? In some ways, very little. In crafting a particular vision of domestic IT policy, the FLOSS mobilization drew heavily on the rhetoric and ideas of an existing transnational community of technological elites. The individuals involved also capitalized on their personal and professional networks to advance their agenda. In these aspects, they resembled more famous networks of technocrats closely.[6] The difference, I argue, stems from their oppositional stance towards hegemonic, neoliberal ideologies of the free market and exclusive, proprietary informational goods. Drawing on the notions of the *insurgent architect* (Harvey, 2000) and *insurgent citizenship* (Holston, 2007), I therefore describe the group of people driving the FLOSS mobilization as *insurgent experts*. Working inside bureaucracies, agencies, firms and organizations, these insurgent experts worked to create counter-hegemonic alternatives to neoliberalism. They undermined the ideological orthodoxies that structure fields of political and economic power. Strategically committed to the exercise of authority, insurgent experts nevertheless resisted the uncritical reproduction of capitalist structures of social domination. As a result, they occupy a contradictory position within social space, transcending the binary of hegemony and counter-hegemony. As Ananya Roy (2006) has put it, an insurgent expert might best be described as a sort of “double agent,” marked by “the simultaneity of complicity and subversion” that defines their political role.

As I discussed in the introduction, I adopt two criteria in my analysis of the Brazilian FLOSS advocates to characterize them as *insurgent experts*. First, the individuals involved in the mobilization framed their own actions in ways consistent with the theoretical propositions of Harvey (2000), Holston (2007), and Roy (2006) outlined above. Second, they sought to utilize technocratic governance institutions to advance an agenda that ran counter to some of the core tenets of neoliberal development policies around information technology and knowledge-based industries. In many ways, these insurgent experts share much in common with other thought leaders or “epistemic communities" of policy elites who are highly motivated to shape policy transformations (Haas, 1992). However, the distinctions I use to define insurgent experts underscores the ideological and practical dimensions of their opposition to neoliberalism as a mode of governance and economic production.

The FLOSS policy mobilization in Brazil offers an example of an elite insurgency against the foundations of the neoliberal knowledge economy. At its core, FLOSS represents a radical departure from traditional software production models as well as the restrictive forms of

6. For example, see Fourcade-Gourinchas & Babb's (2002) discussion of the role of the “Chicago Boys” in promoting economic liberalization in Chile in the 1970's.

intellectual property that dominated the IT industry during the 1980's and 90's (Weber, 2004). In the past decade, FLOSS has emerged as an alternative to the proprietary software sold by multinational giants like Microsoft. Instead of hierarchical firm-based projects and “closed” IP, FLOSS is based on “open” licenses that allow sharing and collaborative, decentralized production over the Internet (Benkler, 2002). As a result, FLOSS has enabled some of the most sophisticated challenges to neoliberal IP regimes as well as corporate monopolies on knowledge-based goods (Lessig, 2004a; Sell, 2003). This has led a number of scholars to argue that FLOSS and other “commons-based” production models could enable high-tech development across the Global South (Benkler, 2006; Evans, 2005; Weber, 2004). The actions of the Lula administration and the FLOSS advocates in Brazil represent the largest state-led attempt to advance this agenda.

Although it is too early to draw conclusions about the long term impact of FLOSS in Brazil, the emergence of these policies as well as the process of their implementation demand further consideration. Through a qualitative, historical analysis of the rise of Brazil's FLOSS agenda, this paper identifies two factors that enabled a group of insurgent experts to promote widespread institutional transformation: *social networks* and *discursive mobilization*. The following account analyzes the experience of the FLOSS advocates within the Lula administration and demonstrates why these factors played such a central role. Using archival analysis, I draw on a variety of primary and secondary sources, including newspapers, magazines, official statements, government documents, public financial records, academic publications, personal weblogs (of key informants), Web sites, and industry reports. I also supplement this data with 40 open-ended key-informant interviews conducted in São Paulo, Porto Alegre, and Brasilia during 2007 and 2008.[7]

The rest of the paper follows a chronological organization: The next section provides a brief history of the Brazilian IT sector and state technology policy. The fourth section details the rise of the politicized branch of the FLOSS movement in Brazil by tracing the professional and political trajectories of a core group of the movement's leaders. I also consider the reasons why the politics of this group enabled them to integrate themselves and FLOSS technologies into the platform of the Worker's Party. In the fifth section, I examine the implementation of the FLOSS agenda during Lula's first term in office and explain how social networks and discursive mobilization figured centrally in this process. Finally, I offer a preliminary assessment of the impact of the FLOSS mobilization and consider its implications for the future of informational capitalism and developmental politics in the Global South.

7. My selection of subjects and sources followed a case-based logic (Small, 2009). I do not claim to draw generalizable conclusions from an unbiased or representative sample of documents, interactions or exchanges among Brazilian technologists and policy-makers. Rather, I contend that my extended engagement with the individuals and texts relevant to the topic of FLOSS politics in Brazil has provided sufficient evidence for me to describe the perspectives, mechanisms, institutions and relationships involved in these processes.

Informational Capitalism and the Brazilian Developmental State

In Brazil, economic globalization has transformed the IT sector and the state. Since the 1950's, a profound tension between global integration and national autonomy has framed Brazil's developmental politics as a whole. National IT policies have embodied the vicissitudes of these ideologies. Brazilian state elites have alternately approached digital Information Technologies as tools of high-modernist industrialization and (simultaneously) economic weapons of anti-imperialist liberation.

Prior to Lula's inauguration in 2003, Brazilian state interventions in IT had occurred in three distinct phases: weak custodial protectionism; strong custodial protectionism; and liberalization. The first of phase of weak custodial protectionism lasted from the mid 1970´s until 1984. During this period, no specialized policy towards the information technology sector existed, but rather a *de facto* regulatory framework (Evans, 1995, pp. 116-120). While this arrangement led to the creation of some domestic IT companies, they remained small, geographically concentrated, and technologically unsophisticated. The state also began to create its own IT firms – o Serviço Federal de Processamento de Dados (SERPRO), a Empresa de Tecnologia e Informações da Previdência Social (DATAPREV), and Cobra Tecnologia) to manage its internal needs.

The second phase of strong custodial protectionism lasted from 1984-1991 and was defined by a so-called market reserve policy. In this period, the *técnicos* succeeded in erecting a legislative greenhouse around the nascent Brazilian IT industry. This market reserve established strict quotas on foreign hardware imports, promoting the growth of a number of domestic IT firms. This national industry remained incapable of sustained innovation and competition at the global level, however. At the same time, the rapidly expanding banking and state-owned sectors fueled an expansion of the national IT market and industry as a whole. The situation produced steady profits and opportunities for the Brazilian subsidiaries of IBM and Unisys, two of the largest multinational IT companies at the time. As a result, these two firms dominated much of the Brazilian market and undermined the supposed aims of national technological autonomy the market reserve was intended to realize.

After the end of the military dictatorship in 1985, Brazil's leaders abandoned long-standing policies of Import Substitution Industrialization (ISI) in favor of market liberalization (Tigre & Botelho, 1999). As part of this process, a new technology law passed under the presidency of Fernando Collor de Melo in 1991 dismantled the market reserve policy, opening the Brazilian IT industry to international competition. Restrictions on imports were replaced by incentives to Foreign Direct Investment (FDI) and human capital development in the form of tax breaks. Several years later, still in the throes of liberalization, President Fernando Henrique Cardoso accepted a package of structural adjustment loans from the IMF which required additional telecommunications liberalization. As a result, the federal government de-regulated its communications infrastructure and sold off the former state telecom monopoly, Telebrás (Afonso, 2007). The state also reduced its investments in the two largest state-owned technology enterprises, SERPRO and Cobra Tecnologia. Finally, conditionalities attached to the loans also specified that Brazil bring its intellectual property laws into compliance with the World Trade Organization (WTO) standards specified in the Trade-Related Aspects of Intellectual Property (TRIPs) Agreement (Sell, 2003). Two pieces of legislation sponsored by the Cardoso administration – the national patent law (1996) and the national software law (1998) – achieved this aim (USTR, 2007, p. 30). While the IT industry as a whole grew during this period, the resulting wealth flowed mainly to multinational subsidiaries.

In the beginning of 1999, a devaluation of the *Real* on global markets caused a sharp contraction of the economy. Brazilian computer programmers suddenly became some of the cheapest talent in the world, driving a surge in outsourcing and customization work. This was reinforced by the first dot-com bust in the United States, leading investors to expand foreign direct investment (FDI) in the BRICS and other so-called emerging markets. Services and outsourcing markets boomed, creating a strategic incentive for large IT multinationals to invest in FLOSS adoption and services. While a few large firms – in particular, IBM and Sun Microsystems – had invested in FLOSS projects since the mid 1990's, the post-dot-com slump attracted increased attention to non-proprietary technologies (Capek et al., 2005). With the exception of Microsoft, whose leadership at the time treated FLOSS as a threat to the firm's core business model, the industry rapidly expanded its use and support of "open" technologies.

In Brazil, the shift towards open source combined with the dot-com economic turmoil to bring rapid recovery in the IT industry. Increased FDI and services revenue contributed most to this resurgence as the market as a whole returned to growth in 2002 (*Anuário Informática Hoje*, 2005-2008) . This growth, and especially the rise of the services sector, would contribute to the viability of the FLOSS agenda. A resurgent IBM led the recovery, and with it the shift towards FLOSS. At the time, IBM had only recently incorporated Linux into its business model, but, FLOSS quickly became central to the firm's expanding services division and global strategy. By 2002, IBM was investing over US$2 billion in Open-Source projects and its services division accounted for approximately 50% of the firm's global revenue (Benkler, 2006, pp. 46-7). For the company's Brazilian subsidiary, this meant a rapid expansion of investments in Linux initiatives and a doubled workforce within five years (*Valor Econômico*, 2004). According to Haroldo Hoffman (2007), the executive in charge of IBM-Brasil's Linux strategy from 2003-2007, this also meant increased lobbying for state Linux adoption and legal support. Hoffman, who previously worked in IBM-Brasil's government relations office, noted that the firm had been making the case for public sector Linux adoption to state officials and political leaders "for several years" before the Lula administration entered office. These efforts would pay off later, in the form of alliances with the network of FLOSS advocates and lucrative government contracts for IBM as federal FLOSS adoption projects gained traction.

The debt crisis had also opened up a political opportunity for the leftist *Partido dos Trabalhadores* (PT). In past elections, PT leader Luiz Inácio Lula da Silva had failed to convince voters that he offered a viable alternative to the economic liberalism. However, Lula's 2002 campaign capitalized on the collapse of the *Real* and the flagging confidence in the Washington Consensus. Promising "a return to development" and "the priority of the social," Lula and the PT brought together an impressive alliance of civil society movements in support of his candidacy. Uncertainty and fear among international investors forced Lula to make a series of public declarations affirming his commitment to honor the national debts and integrate prominent business leaders into his cabinet (da Silva, 2002). While such maneuvers provoked accusations of hypocrisy from the left (Sader, 2005), they preserved the viability of Lula's candidacy. He went on the win the election, claiming over 60% of the popular vote in the second round.

The Rise of the FLOSS Advocates

During the same period in which Lula and the PT rose to power, FLOSS acquired a strong following among Brazilian programmers. However, the adoption of pro-FLOSS policies by the Lula government emerged from the experience and mobilization of a specific cohort of highly-skilled individuals based in a few of Brazil's largest industrialized cities. The members of this group shared a history of participation in large scale social movements and many also had careers in the public sector. Leveraging these experiences in common, they built a network of associations and affiliates dedicated to the promotion of FLOSS across the country. Together with other movements allied with the Worker's Party, these FLOSS advocates coalesced around the time of Lula's election, facilitating the integration of a FLOSS agenda into the policies of the new administration.

Demographically, the programmers that became involved with FLOSS in Brazil had much in common with their peers around the world. Concentrated in urban centers of the country (particularly in the wealthier cities of the south and southeast), they tended to be highly-educated, well-off, professional men who understood some English (Sociedade Softex, 2005). Many were employed in the IT industry, the state, or institutions of higher education. These settings provided easy access to technological infrastructure as well as to social networks of early adopters through which knowledge of new technologies spread quickly.

Within the global FLOSS communities, Brazilian FLOSS developers were also an anomaly in some important ways. Most of the contributors to large-scale FLOSS projects around the world lived in wealthy, Northern, and anglophone regions (Ghosh et al., 2002). Brazil did not account for an especially large number of FLOSS contributions among the non-English speaking regions of the Global South, but a disproportionate number of *prominent* contributors to some *early* FLOSS projects were Brazilian.[8] As a result, FLOSS acquired exceptional visibility among the Brazilian programming community. In addition, many Brazilian FLOSS programmers had a distinctive political experience in comparison with other FLOSS contributors around the world. The computer-savvy men passing through Brazilian universities, technology firms, and public sector institutions as FLOSS spread during the mid 1990's, had all come of age under the military dictatorship. The dictatorship had alienated and politicized millions of people, leading to the rise to massive, leftist movements including the PT. These oppositional movements and their ideologies also had exceptional traction among the graduates of the country's elite universities. Leftist politics and activism thus diffused into the Brazilian FLOSS community more widely than in some other settings.

8 The most well known projects with Brazilian programmers in leadership roles were: Conectiva (Arnaldo Carvalho de Melo), Java (Bruno Souza) and Debian (Fernando Ike). For a recent ethnography of the culture of Brazilian programmers, see Takhteyev (2009).

One prominent individual whose personal trajectory exemplifies the process by which FLOSS was absorbed by members of the Brazilian left is Mario Teza.[9] Born in Porto Alegre in 1964, the same year that Brazil's military took over the state, Teza has spent his professional life working in state-owned technology firms. He locates the beginning of his identification with the left in the 1979 labor strikes that eventually led to the formation of the PT. Only fifteen at the time, Teza went on to attend college in Porto Alegre where he came into closer contact with the labor movement and acquired some technical training. In 1984, he joined a union, the *Federação dos Trabalhadores em Empresas de Processamento de Dados* (National Federation of Data Processing Workers, FENADADOS) in his first job at the state-owned software firm, SERPRO. Teza then rose rapidly through the FENADADOS hierarchy. Following Lula and the PT's 1995 electoral defeat at the hands of liberal Social Democratic Party (PSDB) candidate Fernando Henrique Cardoso, Teza left his position in the national FENADADOS leadership out of frustration with the labor movement, returning to SERPRO.

A few years later, in November, 1998, Teza found himself browsing an airport newsstand on his way to a national SERPRO workers' salary negotiation in Brasilia. By chance, he came across an article in *O Estado de São Paulo* (dos Santos, 1998) about the Conectiva distribution of Linux, the only version of the Linux operating system developed by Brazilians. Conectiva inspired Teza, and, upon arriving in Brasilia, he immediately showed the article to Djalma Valois, the FENADADOS technical director and an old friend from Rio. For Teza (and Valois), the appeal of FLOSS lay in its technical and cost advantages, as well as its potential as a counter-hegemonic tool of anti-capitalist resistance. Looking back at his career, Teza (2008) explained the connections to me:

> By 1989, the labor movement was in crisis - it's still in crisis! But let's put it this way, for some people, we weren't satisfied with the labor movement and beyond that with the democratization - the unions also entered into a system - a status quo, let's say. [The labor movement] didn't subvert the social order after the creation of democracy, and for many of the activists at that time this was not enough. We wanted to do more. And for many of us, *software livre* has enabled us to do more. We are able to take direct action, break paradigms. The labor movement is incapable of this - it raises salaries, but it's a whole corporatist thing, its still very out of date...it doesn't overcome capitalism. In as much as *software livre*, without perceiving it, begins to transcend, at least challenge capitalism, the ownership society, and intellectual property.

The idea of transcending property, and with it capitalism, was not new within the global FLOSS community. However, Teza's stance diverged from those of prominent North American and European FLOSS adherents. International Free Software advocates such as movement founder Richard Stallman employed rhetoric loaded with anti-capitalist implications.[10] Yet, most of the North American and European programmers involved with FLOSS shared an apolitical or libertarian professional culture. Those among them that

9 This biographical account draws on Teza (2000a; 2000b; 2004a; 2004b; 2006 and 2008).

10 See Stallman's provocative arguments on freedom and property in "The GNU Manifesto" (2007 [1984]). Stallman may or may not have intended his arguments to be anti-capitalist, but that they can be (and have been!) read that way. Thanks to Johan Söderberg, who pointed out this distinction.

articulated explicit political views tended towards Anarchist, Libertarian, or Liberal positions that, while explicitly political in a number of ways, did not always lend themselves to institutionalization (Coleman, 2009; Coleman & Golub, 2008). As a result, none had endeavored to create a formal, political mobilization around FLOSS.

Contrastingly, for people like Mario Teza and Djalma Valois, the talk of freedom and autonomy permeating the global FLOSS community resonated with the ideologies of the radical left. When I later asked Valois (2007) why he thought the FLOSS movement in Brazil was so different from the United States, he told me about an encounter he had with one of the most famous North American Linux evangelists, Eric Raymond. Like the two of us, they had been discussing politics:

> Raymond told me he had a gun to protect himself from the government. At this point, I smiled and asked him, 'Eric, how big is your gun?' and Raymond spread his arms wide, like this. [*pause*] Then I asked, 'and Eric, how big are the government's guns?!' [*laughter*] For me, who has worked in state agencies for years, *software livre* always had to do with politics and the public sector... possibly because of the history of the syndicalist movement here, it has also always had to do with socialist politics.

Valois found the notion of single-handedly resisting the state absurd. His idea of effective political action implied a larger scale mobilization of people and resources. Valois then went on describe how the communist cells of the anti-dictatorship movement had inspired his thinking about FLOSS adoption. Such cells, he pointed out, were created with the objective of seizing state power.

Looking to promote FLOSS in the public sector, Mario Teza set about mobilizing within the state technology firms of Rio Grande do Sul. He contacted Marcelo Branco, an old friend who had recently become the Technical Director of PROCERGS, the data processing firm of the state government. The two men had known each other for years as a result of their involvement with leftist movements around the city during the 1970's and 80's. Branco, previously a technical manager with the federal telephone monopoly Telebrás, had entered the local state administration with the election of Porto Alegre's popular PT mayor Olivio Dutra to the office of Governor in 1998. Branco liked the idea of putting together a FLOSS adoption project. Together, he and Teza brought a proposal to the PROCERGS President, Marcos Mazoni, who was also a childhood friend of Branco's. Mazoni gave preliminary support for the project and the burden was now on Branco and Teza to prove that FLOSS could generate tangible advantages for the public sector.

Teza had also started discussing FLOSS with his technician friends and public employees around the state capital. These included Clarice Coppetti, the PROCERGS Commercial Director as well as a former student activist with the PT; and Ronaldo Lages, a PROCERGS technical manager. In addition, Teza contacted Linux user groups and informatics departments at local universities. Within a short time, he had generated enough interest that he organized several meetings to discuss *software livre* and generate ideas about how to implement it in the public sector. Teza, together with Branco and Ronaldo Lages, facilitated these gatherings, the first of which took place in the PROCERGS auditorium on July 30, 1999, with about 40 attendees. They called themselves *Projeto Software Livre - Rio Grande* *do Sul* (the Rio Grande do Sul Free Software Project) or PSL-RS.

In its early days, the PSL-RS focused on spreading information about FLOSS and conducting technical trainings in Linux. Teza invited his old union friend Djalma Valois from Rio to lead classes every week at PROCERGS (Teza, 2008). Demand grew quickly, as did interest in the political philosophies behind non-proprietary technologies, which resonated among the group members. One day during this period, Marcos Mazoni and Marcelo Branco had planned a lunch with another old friend, Walter Pinheiro. A fellow labor activist and former telecommunications manager, Pinheiro had gone on to become a federal representative (*deputado*) with the PT in the northeastern state of Bahia. After a conversation with Branco and Mazoni, Pinheiro expressed an interest in creating a national law based on the PROCERGS FLOSS experience and he convinced Teza (2008) to draft language and send it to one of his aides later that afternoon. The proposed law (number 2.226/1999) - called for preferential FLOSS purchasing in all public agencies and marked an early turning point in the scope of the PSL movement. More than two years before the arrival of the Lula government, the personal and professional networks of the PSL-RS leaders had already succeeded in laying the foundations for a national political debate over proprietary software purchasing. While the federal bill would not garner enough votes in the congress, copycat legislation gained passage through the state legislature of Rio Grande do Sul in 2002.

The impact of the conversation with Pinheiro encouraged Teza and the other FLOSS advocates to pursue more support from the local government. Through the involvement of the PSL-RS, IT managers at many of the state and municipal agencies had already created FLOSS adoption proposals. The PSL leaders also had preliminary meetings with Governor Olivio Dutra to explore the possibility of a statewide FLOSS mandate. Looking to promote the issue, Teza (2000b) wrote a short polemical essay in which he outlined the potential cost-savings that FLOSS could generate for the state, comparing it to expenditures on social welfare in the state budget. Dutra responded by lending additional support to the PSL-RS experiments.

In 2000, the members of the PSL-RS built on their early success and transformed themselves into a national organization. Marcelo Branco became PROCERGS Vice President and created a formal working group within the company to focus exclusively on FLOSS and PSL-RS initiatives. These included the existing Linux training classes and experimental software migrations as well as the organization of an international event to promote FLOSS. Branco and Mazoni hired Teza to join PROCERGS full-time, where he took over the event planning. In May, 2000, The first *Fórum Internacional do Software Livre* (International Free Software Forum, FISL) was held at the *Universidade Federal do Rio Grande do Sul* (UFRGS). Over two thousand people attended, including free software pioneer Richard Stallman and Governor Olivio Dutra. The FISL helped expand the PSL network by attracting participants from the wider Brazilian and global FLOSS communities. Several elite programmers brought connections to top international software firms and FLOSS projects. In addition to Stallman and the Free Software Foundation, these included the Debian Linux community; Sun Microsystems; IBM; Red Hat; Curitiba-based Linux firm *Conectiva*; as well as several universities with strong computer science departments such as UNICAMP and USP.

The first large-scale Linux event in Brazil, FISL also brought international attention to Rio Grande do Sul's FLOSS adoption initiatives. The state claimed vast savings in licensing costs and increased technical stability thanks to FLOSS adoption. The positive attention helped the PSL-RS confirm Dutra's commitment, making him the first of the senior PT leaders to become a strong supporter of public sector FLOSS adoption. Information about the Dutra administration's programs also spread through the FISL network, and other public firms, such as the social welfare administration in the state of Paraná, soon sought to imitate their success. Within a couple of years, PSL's appeared in almost every state and also a number of the larger cities around the country. The movement developed a strong online presence with numerous mailing lists and message boards through which members continue to transmit information.

Around the same time in late 2000, an unconnected FLOSS initiative emerged in the São Paulo government under the new PT mayor Marta Suplicy. In São Paulo, Suplicy had appointed a young professor named Sérgio Amadeu da Silveira to coordinate several projects including the municipal “electronic government” program. Amadeu's trajectory had significant parallels with Teza's and the other PSL leaders. Amadeu was born in São Paulo in 1961 and had joined the PT during the *Direitas Já!* (Rights Now!) campaign of 1984 (Amadeu, 2008). An activist with more militant leanings during the dictatorship, he then worked with the PT's São Paulo political offices from the mid 1980's into the mid 1990's. During this time, he developed personal ties with the highest echelons of the PT leadership. Like Mario Teza, Amadeu reduced his formal involvement with the party after Lula's 1994 loss to Fernando Henrique Cardoso. However, whereas Teza had gone back to a career in technical management, Amadeu pursued post-graduate studies in politics and journalism at the *Universidade de São Paulo*, where he specialized in the politics of networked communications and the Internet. He also continued his work as an assistant and analyst for the PT in the state parliament.

Amadeu learned of FLOSS through his research and, like Teza, Valois and their peers, he understood non-proprietary technologies as strategic tools for combatting inequality in the network society. In his academic work, he discussed how networked information and communications technologies reinforced social hierarchies, resulting in “digital exclusion” for the majority of the poor in a country like Brazil. He wrote, “As happened with mass public education, digital inclusion will not be the work of an 'invisible hand'” (Amadeu, 2000, p. 24). Amadeu claimed that a benevolent developmental state was needed to universalize access and to help break the monopolistic grip of foreign software firms and products on low-income computer users. He undertook to implement his vision through the São Paulo government.

Following Suplicy's inauguration in 2001, Amadeu and his staff initiated various digital inclusion projects using FLOSS to improve Internet accessibility for the city's poor neighborhoods. The largest and most important of these, the São Paulo municipal telecenter network, would eventually offer free Internet access in over one hundred locations on computers running only FLOSS operating systems and applications. With registered users numbering in the hundreds of thousands, the project was the largest municipal FLOSS telecenter network in the country and possibly the world.

During the first year of Suplicy's administration, Amadeu remained unaware of the PSL and its activities in Rio Grande do Sul. However, the geography of the Brazilian left and the small number of state IT projects involving FLOSS quickly brought the two groups into contact. At the end of January, 2002, the city of Porto Alegre hosted the second World Social Forum (WSF). Amadeu had come to participate in the event for the first time and he met Branco and learned of the projects of the PSL as well as their annual forum. A few months later, in May, Amadeu returned to Porto Alegre to participate in the FISL, which by then was in its third year. He gave a presentation on digital inclusion in the São Paulo telecenters and met the rest of the PSL leadership including Teza, Lages, Coppetti and Mazoni.

Less than a year later, Amadeu and the cohort of PSL leaders would become instrumental in the Lula administration's FLOSS policies. By the time Lula won the 2002 election, a public sector FLOSS mobilization had become possible. The *Projeto Software Livre* had national membership numbering in the thousands. A group of executives and administrators at several state IT firms had experience managing large-scale FLOSS migrations. The federal congress included several senators and representatives who supported FLOSS adoption. The PT could even claim successful examples of FLOSS policy implementations in Porto Alegre and São Paulo. Furthermore, the spread of FLOSS within multinational IT firms such as IBM and Sun Microsystems had legitimized FLOSS in the eyes of the global market.

In this early period of the mobilization, a peculiar constellation of ideological and political currents had brought an experienced group of technicians and activists together around a vision of state-led FLOSS promotion. Exogenous factors such as the dot-com slump, the rise of open source in the global IT industry, the debt crisis, and the collapse of the Washington Consensus had facilitated the rise of FLOSS and the PT more generally. However, the PSL-RS and the FISL lay the groundwork for a national project by institutionalizing a network of persons and ideas oriented towards the use of FLOSS in the public sector. Among the group's founders, involvement in the labor movement and the PT as well as executive experience in multiple public IT firms provided the basis for a shared political vision. A number of the early leaders would go on to play central roles in the FLOSS mobilization under Lula. The conjunction of leftist social movements in Porto Alegre and São Paulo at the end of the twentieth century also catalyzed the process by which these persons and ideas coalesced.

FLOSS Advocates in Power

For the PSL, Lula's 2002 victory brought a unique opportunity to take their agenda to federal level. However, an important question remained: how would they carry out the FLOSS agenda in the fragmentary and decentralized context of the Brazilian state? FLOSS advocates needed to “mobilize the state” from within for their new agenda to succeed (Abers & Keck, 2009). I argue that they adopted a multidimensional strategy divisible into three areas: network mobilization; discursive mobilization; and institutional transformation. The first two of these (network mobilization and discursive mobilization) facilitated the third (institutional transformation). This section provides an overview of these three areas of the FLOSS mobilization during the first years of the Lula administration.

Network Mobilization

Despite Lula's victory, the 2002 elections brought uncertainty for the PT in Rio Grande do Sul. In a surprising shift, Olivio Dutra had lost the governor's seat at the same time as the party also lost the Porto Alegre mayor's office. Teza and the other PSL organizers had relied on PROCERGS, the municipal IT departments, and the governor for event funding and administrative support. Said Teza (2008), "nobody knew if there was going to be a FISL or not since there wasn't any more [support] from the city or state."

Meanwhile, in São Paulo, where the core of Lula's organization was based, the outlook was positive. The PT victory meant that he needed to fill thousands of appointments in the federal bureaucracy and local staff and affiliates got first priority for these jobs (c.f., Evans, 1995, pp. 60-66). Many of these hiring decisions fell to José Dirceu, Lula's most trusted aide and co-founder of the PT. Dirceu was known as Lula's "Superminister," and in his new role as the chief of the Casa Civil (comparable to the United States' White House Chief of Staff), Dirceu oversaw the executive branch. Among the dozens of agencies under Dirceu's authority, the Institute for Information Technology (ITI) was a low priority. The Cardoso administration had created the ITI to manage the state cryptographic and certification systems. As such, it was one of the many unelected posts through which the administration exercised influence over the semi-autonomous ministries and public-owned firms. Without a clear idea of what this entailed and short on time, Dirceu called Sérgio Amadeu. While Amadeu had no cryptographic training and less than two years experience in public administration, Dirceu offered him the presidency of the ITI. Amadeu told Dirceu he would consider the post.

A few days later, Amadeu traveled to Porto Alegre, where the World Social Forum was again taking place. In Porto Alegre, he met with Marcelo Branco and Mario Teza. According to Branco (2008), Amadeu told them, "they've offered me a position as President of the ITI. I don't know exactly what the ITI is, but I'm going there to implement *software livre*." Amadeu wanted help locating competent personnel for the ITI and crafting a national FLOSS strategy. Said Branco (2008), "we decided to put all our support behind him." Amadeu (2008) then returned to Brasilia, where he offered Dirceu and Lula a deal: "both of you support me with the *software livre* implementation, and I'll make sure this thing, the ITI, works out." The party leaders agreed to this proposal. Amadeu's appointment to the would shape the federal FLOSS agenda during the rest of Lula's first term.

Dirceu then created a high-level Committee for the Implementation of Software Livre (or CISL) to form a national FLOSS action plan and named the President of the ITI – Amadeu – to chair it. When it met for the first time in mid-2003, the CISL served an explicit agenda-setting function and helped to activate the network of FLOSS advocates. The meetings gathered representatives of over forty government offices, firms, and agencies. Special invitations were also extended to a handful of participants from the PSL community in Rio Grande do Sul, including Teza, Branco, and Ronaldo Lages. Following several meetings, the CISL issued a strategic planning document to guide the subsequent actions of the administration and the state agencies (CISL, 2003). Lula officially endorsed the plan in October (da Silva, 2003), issuing a decree that created eight committees to oversee federal IT policy implementation. Not surprisingly, the first committee on the list was dedicated to implementing FLOSS adoption across the state agencies and fell under the authority of the ITI president – Amadeu.

As Amadeu set out to implement FLOSS-based reform, the PSL network served as a crucial resource. Many of the PSL members had extensive experience in the IT industry and in state-owned technology firms and Amadeu appointed some of them to join him at the ITI, in state-owned firms, and on various inter-agency committees. For example, Renato Martini, a PSL ally from Rio, became the ITI Vice President and Djalma Valois was hired to lead the ITI's new FLOSS training programs. Amadeu also brought most of his staff from the São Paulo e-government programs to join him in his new agency. In addition, the growing need for FLOSS expertise in government IT departments increased demand for administrators and programmers experienced with FLOSS. Logically, many of these individuals were drawn from the PSL community's ranks.

Beyond Amadeu's efforts, several of the core PSL-RS leaders also received appointments in other federal agencies. The former PROCERGS executive Clarice Coppetti became Vice President in charge of technology at the second largest national bank, the Caixa Econômica Federal. Prior to her arrival, a few mid-level managers and technicians had experimented with FLOSS. Under Coppetti's guidance (and in response to the explicit agenda set in motion by Amadeu and the ITI), these experiments were expanded. In addition, the Caixa migrated thousands of workstations and the technical backbone of the national lottery system to FLOSS platforms (Maia, 2007).

At the same time, some participants in the government's FLOSS adoption projects did not share the politicized views of Amadeu or the PSL leaders. In the largest state-owned bank, the Banco do Brasil, a small group of high level technicians had initiated the firm's FLOSS migrations independent of the PSL. For them, FLOSS had more to do with technical stability, security, and flexibility than national sovereignty or a critique of multinational capital. They described how the PT's new initiatives had created an opportunity for them to promote ideas they had been pursuing for years (Pena, 2007).

Other members of the IT industry without strong political or public sector affiliations also played an important role in the mobilization process. FLOSS advocates held positions in multinational tech firms, small local consultancies, and NGO's and in many cases, the rise of FLOSS within the federal government presented a business opportunity for them. Consequently, the PSL drew larger and larger numbers of participants to the annual forum, its regional conferences, and numerous email lists. At the same time, "buying in" to the vision of the leadership of the PSL or of the PT was not a salient concern for some of these new participants. One IBM executive told me he had begun attending the FISL in 2005 because of its significance for the company's FLOSS initiatives. With a wry smile, he added that he always made sure to wear his oldest jeans, "the more holes the better" and did not shave for a few days prior to the event, so that he could blend in with the crowd (Hoffman, 2007). For him, integration into the PSL community was a profitable tactic in the new political environment.

Together, the mobilization of personnel behind the FLOSS agenda enabled Amadeu and the other leading advocates within the administration to consolidate support for their projects. The shared commitments and existing social ties between these individuals (through the PT, the PSL, or the state administration itself) reinforced the organizational capacity of the FLOSS mobilization as a whole. They were also able to use the existing PSL network and infrastructure to recruit new members and spread information. The election of Lula created political conditions within which peripheral networks of FLOSS sympathizers outside the core of the PSL and the PT could activate in order to advance the government's agenda indirectly.

Discursive Mobilization

The mobilization of the network of FLOSS advocates encountered resistance and outright opposition among some of the state elite. A number of Lula's senior ministers did not agree that non-proprietary production was an effective economic strategy. In particular, Luiz Fernando Furlan, the Minister of Industrial Development, defended the proprietary, export-driven model of growth pursued by the Cardoso administration. In this context, Amadeu looked to convince federal administrators and politicians that the switch to FLOSS offered sufficient political and economic benefits to offset the costs. To do so, he pursued an aggressive *discursive mobilization*, depicting the national ICT policies in normative cultural and political terms.

A charismatic public speaker, Amadeu quickly became the spokesman of the FLOSS agenda within the administration. His arguments served as “the point of a spear” behind which the FLOSS agenda could advance (Cassino, 2007; Martini, 2007). In numerous interviews and editorials, he articulated a grand, radical vision of the developmental politics of software, knowledge, and digital networks. Drawing on the ideas of scholars such as Boaventura de Sousa Santos, Manuel Castells, Yochai Benkler and Lawrence Lessig, he painted a stark picture of the network society, defending the government's preference for FLOSS:

> Brazil has more than the right, it has the need to utilize technologies that enable the growth of its technological autonomy, its participation as a developer of solutions in the information society, the reduction of costs and the expansion of its independence in the face of international monopolies. (*ComCiência*, 2004)

From Amadeu's (2001; 2003) point of view, state-led FLOSS adoption was not at odds with the logic of the market, but rather a tool that could enhance the distributive function of the market and promote national economic growth. In this way, Amadeu argued that the licensing royalties charged by wealthy Northern firms (like Microsoft) represented an exploitative tax on knowledge-based digital goods. According to him, state-led FLOSS adoption would enable the Brazilian economy to wean itself off these expensive technologies and, in doing so, promote national education, economic growth, autonomy, and development. The adoption of non-proprietary technologies within the public sector would (in theory) reduce foreign intellectual property dependencies, and catalyze innovation and industrial upgrading among domestic firms. Not only would the resulting savings on licensing costs enable Brazil to spend more on closing the digital divide, but the preference for FLOSS would prevent lock-in to proprietary products, the costs of which would rise over time. The state and its citizens would benefit from the enhanced transparency and security provided by programs written with non-proprietary code. Furthermore, by embracing collaborative knowledge-production over the Internet, Brazil's citizens would benefit from and contribute to the information commons. FLOSS would thus serve as the foundation of a competitive ICT economy in the global market; an educated, digitally-connected citizenry; and a well-ordered and sovereign nation-state. It would facilitate comparative advantage without compromising national security. Furthermore, the spread of FLOSS would strengthen Brazil's terms of trade as well as its non-proprietary trade agenda.

Amadeu's discursive offensive generated political leverage for the FLOSS advocates. He attracted domestic and international press attention to the PT agenda. The idea of a state-mandated FLOSS migration caught the eye of editors in Washington, New York, and London, who characterized Amadeu as the latest radical Latin American politician to reject multinational corporate influence (Benson, 2005; Clendenning, 2003; *The Wall Street Journal*, 2003). These articles, disseminated an image of Amadeu (and Lula) as the leaders of an anti-imperialist, anti-corporate vanguard. This image reinforced the PT's efforts to position itself at the forefront of the Latin American left at the same time as it brought global recognition to Brazil's FLOSS stance.

Amadeu argued against the inherent benefits of the market or technological progress, rejecting the terms in which strong IP rights advocates discussed informational goods. Instead, he situated the political economy of networks in a broader history of global capitalist hegemony:

> If the market had the capacity to include people in the information society, it would have already done it because to do so would produce a lot of money. It is not capable of doing it because the market, in and of itself, is exclusive. Brazil is a country with highly concentrated wealth. People don't have a computer in their home, they don't have a telephone line...*The market is not going to resolve the problem*. (*Portal do SERPRO – Notícias*, 2004, emphasis added)

According to this view, information technologies could produce repressive *or* egalitarian social orders – the outcome depended on the relations of knowledge production within a given society. The state, Amadeu claimed, had the responsibility to defend citizens' access to public goods. This was a harsh rejection of the the Washington Consensus view that had dominated public debates about technology and development in Brazil throughout the 80's and 90's. By relentlessly connecting the arcana of operating systems to the circumstances of children in *favelas*, Amadeu framed the digital divide as a moral and political problem, rather than a technical one.

Amadeu did not act alone in spreading this politicized vision of the knowledge economy. In the national congress, Walter Pinheiro (2005) – the representative from Bahia who had attended FISL years earlier – argued in favor of new legislative measures on the basis of the digital inclusion agenda. Sérgio Rosa (2004), a Vice President of SERPRO, likewise undertook to revitalize the aging firm's operations by offering increased FLOSS services in an effort to catalyze FLOSS demand throughout the IT industry. Similar events occurred at

DATAPREV and Cobra Tecnologia (Cassino, 2007; Teza, 2008). Amadeu's rhetoric provided a shared language for justifying these initiatives.

Amadeu's sheer vehemence contributed to his prominence during this time. Frequently, he characterized Microsoft as a rapacious, anti-democratic, corporate villain. Representatives from Microsoft-Brazil usually responded to these attacks indirectly, defending the quality of their products and asserting the importance of “free choice” for all software consumers (Braun, 2006). On one occasion, however, the verbal sparring between the two parties escalated. A March, 2004 article in the popular Brazilian magazine *Carta Capital*, quoted Amadeu accusing Microsoft of “drug dealing practices” for distributing software at no cost to poor Brazilians (Marques, 2004). In response to this provocation, Microsoft-Brazil sued *Carta Capital* and Amadeu for defamation. The defamation case legitimized Amadeu's claims and increased his international status as FLOSS supporters (and Microsoft detractors) from around the world rallied to Amadeu's support (e.g. Lessig, 2004b). Brazilian courts eventually dismissed the charges.

The “digital drug dealing” incident illustrates how Amadeu's discourse produced concrete impacts on the political environment. He gave the FLOSS agenda a recognizable public face and popularized the issues at stake. Influential technologists, executives, and politicians felt obligated to justify themselves on Amadeu's terms.[11] At the same time, members of the PSL and the PT recognized that Amadeu's strength lay in his ability to shift public debate. Few of them harbored illusions about his lack of administrative experience. Renato Martini, Amadeu's successor at the ITI, said:

> Sérgio did not come here to make his career in the government, to stay here forever. He said to me when he arrived and we were talking, 'I'm a professor. I came here to create confusion, create a tumult, and go home'...in truth, the *Software Livre* project in that era was the discourse of Sérgio Amadeu and it was successful. (Martini, 2007)

Other FLOSS advocates echoed this sentiment (Cassino, 2007). Martini's statement, however, underscores the extent to which Amadeu intentionally pursued discursive mobilization as an end in itself as well as a means to more tangible reforms.

Institutional Transformation

Expanding on Amadeu's efforts, the FLOSS advocates promoted institutional transformation in four primary arenas: domestic legislature; international governance forums; public agencies; and state-sponsored “digital inclusion” programs. Overall, these efforts met strong opposition and enjoyed limited success. Where success did occur, it seemed to come through the collaboration of allies outside the PSL. The domestic legislative agenda failed to get very far during Lula's first term.

FLOSS supporters within the congress sought to replicate laws from Paraná and Rio Grande do Sul (Mazoni, 2003; Teza, 2004b). In both of those states, the local legislature mandated

11 This was driven home to me by a number of my interviewees (Hoffman, 2007; Martini, 2007; Valois, 2007).

the use of FLOSS in all levels of public administration. The proposed federal measures likewise sought mandatory FLOSS adoption in public agencies as well as state-run schools and hospitals (Kaminski, 2007; Pinheiro, 2005). For some skeptics, these proposals resembled the “market reserve” policies of the 1980's too closely. The new measures would have also posed technical challenges to decrepit legacy systems still handling much of the state's computing. Faced with such high political and economic costs, the congress voted down the proposals.

The administration pursued more flexible reforms at the international level. For the most part, these did not involve the participation of PSL community members. Nevertheless, the political stance mirrored the domestic FLOSS agenda in key respects. At both the WTO and the World Intellectual Property Organization (WIPO), Brazilian negotiators built a Southern alliance behind a “pro-development” trade agenda to restructure the regulation of global markets (Paranaguá, 2005; Shadlen, 2004). The creation of a permanent Committee on Development and Intellectual Property (CDIP) at WIPO in September 2007 indicated partial success of Brazil's efforts. Nevertheless, representatives of wealthy, Northern states continue to actively resist these movements in a number of forums (Sell, 2008; Shaw, 2008).

In public agencies, ministries and firms, the FLOSS advocates promoted migrations to FLOSS and technical training. The ITI and CISL coordinated these efforts. The most extensive migrations occurred in the state-owned technology firms where FLOSS supporters already held (or acquired) influential positions. Among these, the *Previdência Social* (social welfare administration), and its IT management organization DATAPREV led the way, migrating many databases, servers, and Web platforms onto FLOSS (DATAPREV, 2004; Teza, 2004a). These migrations built on experiences under the Cardoso administration, but now involved core PSL members such as Mario Teza. A similar pattern unfolded at SERPRO, the Federal Data Processing Service firm affiliated with the Ministerio da Fazenda (Ministry of Finance). There, Vice President Sérgio Rosa championed the FLOSS agenda as SERPRO migrated many of its systems, beginning with thousands of servers and workstations (Kuhn, 2007). With the support of the ITI and CISL, SERPRO also promoted and managed migrations for client organizations within the federal administration, and developed several custom FLOSS applications for government agencies' use.

Approximately a dozen other federal entities followed the lead of these early-adopters. Among them, Petrobrás, the state-owned energy giant, and the Ministry of Culture invested most heavily in FLOSS. Security concerns led the Brazilian Armed Forces and the Intelligence Service to transition onto Linux-based systems. Additional migrations occurred in the Ministry of Science and Technology, the Ministry of Industrial Development and Commerce, as well as the national postal service. The pace of migration moved steadily between 2003 and 2006. The transitions focused on “back-end” IT operations, with a smaller number involving systems in use at employee workstations.

The administration promoted “digital inclusion” and FLOSS-based IT education through market-based incentives and state-sponsored programs (Afonso, 2007). These initiatives derived from the CISL's strategic recommendations and targeted different socio-economic strata of the population. Among them, the *PC Conectado*, *Casa Brasil*, and *Centros de difusão da tecnologia e conhecimento* (Technology and Knowledge Diffusion Centers, or

CDTC's) programs had direct support from the ITI and the FLOSS advocates. The CDTC also received US$1 Million in seed funding from IBM in early 2004, followed by a similar amount in 2005 (*Business Monitor Online,* 2005; McMillan, 2004). However, opposition from the finance and development ministries limited the CISL's ability to implement all three proposals effectively (*Valor Econômico,* 2005b).

Changing Momentum and Preliminary Assessments

Early in Lula's third year in power, a series of political scandals altered the balance of power within the administration. In June, the media uncovered a P.T. vote-buying scheme that reached high into the party leadership and included "superminister" José Dirceu. Although he denied the allegations, Dirceu resigned his post as Chief Minister of the Casa Civil and returned to his previous role as a São Paulo state representative (*Folha de São Paulo,* 2005). The FLOSS agenda had lost one of its most powerful allies. Even before Dirceu's departure, Sérgio Amadeu had expressed frustration with the glacial pace of government procedure and wrangling over funds. With Dirceu gone things only got slower. After the delay of the *PC Conectado* program, Amadeu had additional funding requests for digital inclusion programs held up by the Ministry of Planning for several months. Fed up (and perhaps discouraged in Dirceu's absence), he resigned in the middle of August (*Valor Econômico,* 2005a). Dilma Rousseff, Dirceu's replacement as Chief Minister of the Casa Civil, announced that the administration would continue to promote FLOSS in ministries and state-owned firms as before. Nevertheless, the sudden personnel changes were a setback for the FLOSS mobilization.

Despite Dirceu and Amadeu's exit, the FLOSS advocates had initiated an impressive set of changes by 2006. It remains to be seen what long-term results these changes will bring about. Preliminary assessments suggest that while national debates about IT have become more politicized, the administration's strategy has not yet transformed the state or the IT market in the way Amadeu and others argued that it would. This should not be surprising given the scope of Amadeu's rhetoric and constraints on some of the changes that were implemented. In addition, while the FLOSS advocates built support for non-proprietary information within the state, their ability to reverse long-term IP trade inequalities or transform the IT industry was limited. The global IT economy continued to evolve rapidly and off-shore trends affected the Brazilian market in unforeseen ways.

Despite such limitations, the FLOSS mobilization remains a unique attempt to pursue an alternative to neoliberal development politics by means of insurgent expertise. In interviews, many of the FLOSS advocates recognized the challenges and uncertainties that have constrained the success of their efforts. At the same time, they offered divergent views as to why the grand radical vision articulated at the outset of the Lula administration has proven so elusive. Sérgio Amadeu (2008) maintains that a combination of proprietary firm lobbyists and ideologically motivated opposition within the government ministries prevented him from executing FLOSS migrations and digital inclusion projects on a broader scale while at the ITI. Commenting on the different levels of adoption in some state agencies versus others, he reflected:

> Where is the instrument that legally enforces technological policy? It doesn't exist. The proposal [for a mandatory FLOSS adoption law] exists – the proposal is there. It's waiting...But that is where the barrier remains because that is where the issue ceases to be a conversation, a voluntary idea that the agencies adopt...and becomes a norm within the government.

Absent the force of law, Amadeu believed that dissenters would never relent.

In contrast, Marcelo Branco (2008) argued that the shortcomings of Lula's first term stemmed from the personnel decisions made by the PT leaders – specifically in their choice of the inexperienced Amadeu to coordinate the agenda. He emphasized how, "Some people...that had political experience and administrative experience were not considered during the formation of the first Lula government." Indeed, among the original PSL leaders from Porto Alegre, only Clarice Coppetti was immediately offered a high ranking position in Brasilia. Teza won an elected spot on the national Committee for Internet Governance, but without a formal post within a federal agency, he could do little to affect broad changes at the national level. Marcos Mazoni accepted an offer to direct CELEPAR, the state technology firm of Paraná, where he went on to oversee extensive FLOSS migration projects. Branco himself worked as a consultant on some of the FLOSS implementation committees during the first two years of the administration, but then left and took a temporary position in the regional government of Cataluña, Spain. Branco's experience shows how only some of the wisdom accumulated in the state agencies of Rio Grande do Sul made it into the federal FLOSS mobilization.

Arguably, the most impressive achievement of the FLOSS advocates was the institutionalization of the movement itself. An extensive social and professional network of FLOSS advocates remains inside the state bureaucracy. This network continues to grow through events such as the Fórum Internacional do Software Livre and groups such as the PSL. The FISL now enjoys support from the federal government and numerous private sector firms. New leaders and initiatives have also emerged since 2006 following Lula's election to a second term in office. Of particular significance for the old PSL leaders, Marcos Mazoni was appointed to be the President of SERPRO at the outset of Lula's second term, signaling that the FLOSS agenda may have entered a new phase focused on further institutionalization.

Conclusions

The ability of the FLOSS advocates to promote their agenda resulted primarily from their collective mobilization in state and civil society organizations. Built on the strength of a social and professional network of experts, the FLOSS advocates drew strength through affiliation with the PT as well as the federal government, disseminating ideas and projects across a fragmented bureaucratic field. From this position, FLOSS advocates challenged dominant ideas about the nature of the knowledge-based economy through a radical, politicizing discourse. The discursive component of the agenda transformed public debates about information technology and challenge the hegemony of proprietary information regimes in Brazil and abroad. At the same time, the FLOSS advocates met with resistance in many of the federal bureaucracies as well as some private sector groups. Their experience does not provide a generalizable example of how to transform developmental states or implement FLOSS across the Global South. Instead, the case of the FLOSS advocates in Brazil reveals key factors and strategies that shaped this process in a specific context and with theoretical as well as comparative implications.

The FLOSS advocates positioned themselves as counter-hegemonic, insurgent experts in several different ways that correspond to both my criteria of self-representation and practical action. More than any other individual, Sérgio Amadeu promoted a radical discourse aimed at re-politicizing information technology and the role of the state in setting industrial development policy. From his position in the ITI, Amadeu and his colleagues also performed a coordinating role between several of the state agencies and state-owned enterprises, promoting a series of policy initiatives across the federal bureaucracy. At the same time, people like Marcelo Branco and Mario Teza worked outside of the formal structure of the state to expand the social and professional network of FLOSS supporters through the FISL and other PSL projects. Finally, and perhaps most significantly for the long-term survival of the FLOSS agenda in the Brazilian state, individuals with positions in key state-owned technology firms, banks, and enterprises (including, among those mentioned or cited in this paper, Marcos Mazoni, Clarice Coppetti, Paulo Maia, João Cassino, Ulisses Pena, Sérgio Rosa and Deivi Kuhn) sought to establish FLOSS in the core operations of their organizations. In aggregate, these efforts may have produced some successes and some failures, but they unquestionably altered the ideological and organizational landscape of technology policy-making, re-framing subsequent debates around questions of access, freedom, and openness, in addition to questions of profit. Consistent with personal experiences in the labor and student movements under the dictatorship, many of these individuals saw their actions as a continuation of political struggles for national development, economic equality, and access to informational resources.

At the same time, the FLOSS advocates' position as insurgents was neither uniform, constant, nor entirely consistent with the conditions of the global information technology industry. On some occasions, as in the case of the cooperation between several federal agencies and IBM, strongly politicized FLOSS advocates capitalized on alliances with the private sector while downplaying the ways in which these alliances contradicted some of the anti-corporate rhetoric employed by Amadeu and others. In addition, the alliances between the FLOSS advocates and large IT firms such as IBM and Intel were also indicative of the fact that the mainstream of the global IT industry had embraced FLOSS during the early 2000's. This transformation does not undermine the possibility that FLOSS could lower royalty and licensing costs while advancing certain forms of technological autonomy in Brazil; however, it complicates the idea that FLOSS constituted an alternative to multinational capital accumulation. Finally, a number of individuals who identified strongly as advocates of public sector FLOSS adoption did not necessarily see themselves as leftist insurgents. Adopting more liberal stances reminiscent of those held by FLOSS elites in the Global North, these individuals tended to be talented engineers who just wanted to maximize the quality, performance and affordability of the technologies they used. In a few cases, such as the Banco do Brasil, these less ideologically committed FLOSS advocates made the point that the political salience of FLOSS had helped them make their case to supervisors eager to score points with the new administration.

The relationship between the PT and the FLOSS advocates waxed and waned over the course of this period. The early affinities between key FLOSS advocates' (such as Valois, Teza, Branco, Coppetti, Mazoni, and Amadeu) ideas of political and technological freedoms as well as their connections to the labor movement facilitated the emergence of a network of FLOSS advocates as well as a coherent FLOSS agenda. Similarly, individual PT leaders in some of the most politically and economically influential regions of the country, such as Olivio Dutra in Porto Alegre and Jose Dirceu in Sao Paulo, went to great lengths to incorporate the FLOSS advocates into public institutions and the PT agenda at key moments. However, outside of Porto Alegre, Sao Paulo, and later Bahia and Parana, questions of FLOSS policy did not gain much traction within the party – even after Lula's election to the presidency and the appointment of several FLOSS advocates to key positions in the federal bureaucracy. In addition, some PT party elites, such as the finance and development ministers of the Lula administration, resisted aspects of the FLOSS adoption agenda within the federal bureaucracy. In this regard, the ability of individuals like Amadeu to frame the FLOSS agenda in such radical terms may have helped to align FLOSS adoption with the PT's public image at the same time as it pushed away some of the party's more centrist elements.

The context of the domestic and global IT industry also played an important role in enabling and shaping the FLOSS mobilization, as the FLOSS advocates enjoyed the support of key multinational and domestic IT firms that rode the rising tide of IT services following the 2001 dot-com bust. This alliance appeared somewhat contradictory at times, but generally worked to the advantage of all involved. Politically and financially, IBM and other FLOSS-friendly multinationals lent support and credibility to the FLOSS adoption efforts. While they rejected the radical terms in which some FLOSS advocates framed the agenda, they also recognized this as just another cost of doing business with the PT. In exchange, several firms (but IBM in particular) reaped large, long-term contracts with government agencies; public relations support for FLOSS; and a strong, vocal critic of Microsoft, one of their largest competitors in the marketplace. In a strictly causal sense, it is impossible to say whether private sector support was necessary for the FLOSS agenda to advance as far as it did, but it is hard to imagine that the case for federal FLOSS adoption would have been taken seriously in the absence of a viable marketplace for FLOSS services and support.

As a contemporary example of insurgent expertise, the FLOSS mobilization in Brazil illuminates several key dynamics of elite-led policy change. First, the FLOSS advocates' creation of a network across many state agencies and civil society groups implies a model of mobilization in political and economic fields dominated by expertise. In this case, national elites with prior connections to public institutions established a coalition that mitigated the fragmentation of Brazil's state bureaucracy. Other studies of expert networks intervening in the knowledge-based economy demonstrate similar characteristics. Saxenian (2006) illustrates how highly trained elites utilized their social networks and cross-cultural knowledge to create successful technology firms in India and China. Kapczynski (2008) considers how a community of technically-savvy lawyers and policy advocates mobilized to promote flexible IP at the multinational level. Taken together, these cases suggest that expert communities can and do use their skills to promote economic equality and growth in the Global South. The extent to which the collective participation of technological, legal and scientific elites may determine the success or failure of such strategies remains to be seen. In the case of the FLOSS advocates it may be that their coordinated efforts ultimately will neither overcome the disjointed structure of the Brazilian state nor the political economic resistance to their agenda. Subsequent comparisons across national and regional contexts should explore the factors that predict these differences in FLOSS-related policy agenda-setting as well as the consequent variations in policy impacts.

In more general terms, the history of FLOSS in Brazil provides a reminder that technocratic governance institutions are vulnerable to appropriation and transformation. These conclusions should not seem surprising in the wake of the neoliberal revolution that swept through the post-soviet states and much of the Global South during the 1980's and 90's. While national socio-economic conditions played a key role in determining the impact of neoliberal policies (Fourcade and Babb, 2002), global diffusion of such policies largely took place through an epistemic community of individuals with similar training and values (Woods, 2006). Expert reactions against the logic of the market are the inverse of these processes and complement other forms of counter-hegemonic struggles (Evans, 2005, 2008).

Lastly, as the importance of policymaking arenas dominated by technocratic experts have grown since the mid-twentieth century, the question of how to make public debate over complex issues more accessible and democratic has emerged as a major political and scholarly concern. Both the experience of the FLOSS advocates in Brazil as well as the A2K mobilization described by Kapczynski (2008) suggest that the possibility of opening up a public debate around intellectual property rights may hinge on re-framing technical topics so that their moral and political implications become more transparent. This is a suggestive finding that merits substantive follow-up. Comparative research should analyze mechanisms and techniques of mobilization in the context of development politics and technology policy. The resulting insights can, in turn, facilitate an enhanced understanding of how low and middle income countries might create policy space to bring about enhanced growth, innovation, and equality in an information age.

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Participation in Online Creation Communities: Ecosystemic Participation?

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Abstract

The tendency to strong inequality regarding the distribution of content contribution is characteristic of most online creation communities. In order to explain the results of participation distribution, an analysis of the main organizational characteristics and logics of participation in online creation communities is presented, and a conception of ecosystemic participation explored. The empirical analysis is based on a statistical analysis of 50 cases and a comparison of two cases studies: Wikipedia and opensf.net.

Keywords: Online creation communities, participation inequality, ecosystemic participation

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Participation in Online Creation Communities

Conventional participation in most industrial countries has decreased in recent decades (Blais, 2000). Furthermore, citizens' discontent with the mechanisms and institutions of representative democracy has increased (Pharr & Putnam, 2000; Dalton & Wattenberg, 2000). From the perspective of the evolution of democracy, it could be argued that the representative democratic system is in a period of turbulence and readjustment. Some authors also argue that the crisis of conventional forms of participation creates resources for new forms of participation (Norris, 2002). In this line of thinking, the crisis of participation in conventional politics has been accompanied by the increase of non-conventional forms of participation and public expression (Norris, 2002; Cain, Dalton & Scarrow, 2003; Stolle, Hooghe & Micheletti, 2005). An area of particular interest is how the Internet and the new technologies of information and communication (NTI) in general are related to the increase of non-conventional forms of participation. Previous research on the Internet and politics debate has mostly concentrated on well-established and traditional actors and with mainly offline bases (Trechsel, Kies, Mendez, & Schmitter, 2003; Norris, 2002; Römmele, 2003; van den Donk, Loader, Nixon, & Rucht, 2004; Vedel, 2003). The analysis presented in this paper instead concerns online creation communities.

Online creation communities (OCCs) are a specific type of online community. OCCs are a form of collective action performed by individuals that communicate, interact, and cooperate in several forms and degrees of participation which are integrated in an eco-system. This communication, interaction, and cooperation is mainly via an Internet-based platform for participation and with the common goal of knowledge-making and sharing. OCCs result in a *digital common*, that is, an integrated resource of information and knowledge (partly or totally) collectively owned and freely accessible to third parties.

Knowledge-making in the frame of this research is defined as the process of the creation and systematization of socially dispersed information and knowledge resources and cognitive capabilities resulting in evolving bodies of shared knowledge.

Other terms used to refer to these types of online communities are mass collaboration, common-base peer production, and/or social production (Leadbeater, 2008; Benkler, 2006).

The OCCs emerge in diverse fields, including scientific communities (i.e., multi-media content, scientific resources, political organizing, or linguistic communities).

OCCs are an interesting form of collective action from two points of view. First, OCCs are interesting from the point of view of constituting spaces for civic engagement, the dissemination of alternative information, and participation in the public space, which could contribute to enriching public discussion in a representative democracy. Second, OCCs are interesting from the point of view of citizen engagement in the provision of public goods and services based on a *commons* approach, that is the provision of public goods not necessarily linked to the state or other conventional political institutions.

Empirical Research Design

The combination of several approaches and perspectives characterizes the empirical research design. Both offline and online methods are used; and a quantitative large-N analysis and a qualitatively-oriented comparison of two cases studies contribute to the triangulation of methods.

The large-N Web analysis was based on a sample of 50 units and was analyzed by elaborating a codebook, collecting data of digital threads, and producing a descriptive statistical analysis of the data.

For the sampling, a snowball method was used. The strategy for the selection of the units for the sample was based on covering a variety of OCCs following several sampling guidelines: those with international scope; a balance between larger and smaller OCCs; equilibrium between more recent and older organizations; and a balance between the several types of knowledge content.

After the sample was built, I designed a codebook for the large-N (available on request) analysis. The codebook aimed at conducting a structured analysis. The codebook consisted of a set of options concerning the presence or otherwise of indicators. I followed the codebook for each case, visiting and observing the Web site of each OCC. During the "field notes" stage the general impression was also kept. The data was collected in May 2008 and in January 2010. The large-N analysis helped to define the analysis for the case studies and their selection.

The in-depth case studies focused on Wikipedia and openesf.net. Starting in 2001, Wikipedia is one of the great successes of collective action on the Web. It is an online encyclopedia built through the collaboration of volunteers on the web. It contains millions of articles and ranks among the top ten most visited sites. It is based on wiki technology, every one of its articles can be edited by anyone – credentials are not checked. Changes are visible to everyone immediately, without any review cycle. The platform that hosts Wikipedia is provided by the Wikimedia Foundation.

The other case study is openesf.net. Openesf.net is a platform provided by the European Social Forum (ESF). The ESF is the main gathering of social movements in Europe. It is the European section of the World Social Forum, which started in 2001 as a meeting of alternatives and to critique the neoliberal approach of the World Economic Forum of Davos. Both Social Forums host platforms for archiving information on the forums, developing the forum program, facilitating the network among the forum participants, and allowing the collective (re)construction of the memory of the forums. It covers issues such as the alternative economy, neoliberal criticism, and environmentalism, among other issues.

One of the positive aspects of this case selection is the independence of the cases. These cases have multiple causes, diverse roots, and varied trajectories. However, similar organizational principles are involved regardless of the substantive contexts.

I combined several methods in carrying out these case studies. Furthermore, I did not follow the same plan for each case. Before starting this work, I had already researched the Social Forum case study, but not alongside Wikipedia. In this regard, I carried out fewer interviews for the Social Forum case because I was already familiar with it. Furthermore, for the Social Forum case, I developed statistical analysis of participation data for Openesf.net, since such data were not already available, while for the Wikipedia case, I did not analyze data on participation because there was already information available from previous empirical research.

Data on the social forums was collected and developed during 2007 and 2008. The Wikimedia data collection took place between July 2008 and August 2009.

The data for the openesf.net case study was collected using online ethnography; participant observation at meetings of ESF organizers; 25 interviews of main ESF organizers, openesf.net providers and participants, assuring a plurality of nationalities and backgrounds; and most importantly the statistical analysis of participation data available about the Web site.[1]

The data collection for the statistical analysis of participation in openesf.net was extracted through online ethnography on 4, 5, 6, and 7 March 2008. The data was extracted for the complete population (220 participants and 62 projects). Field notes were also made during the data collection. (The codebook on participation data can be provided on request).

It is worth mentioning that Openesf.net closed in March 2010 due to a lack of resources of the ESF.

The Wikipedia case study evidence was gathered through online ethnography; participant observation at meetings of Wikipedians, the annual meeting of Wikipedians (Wikimania), and at the Wikimedia Foundation headquarters; and 35 interviews with Wikipedians of several nationalities and backgrounds. For the Wikipedia case I did not analyze data on participation, using instead the available data from previous research. More concretely, I used the data available from the wiki analytics developed by the Wikimedia Foundation and available at the Web site, and the research conducted on the ten bigger linguistic Wikipedia by Ortega & Gonzalez-Barahona (2009).[2]

[1] Online ethnographies were conducted for the mailing list and online spaces at the openesf.net Web team 2008, Openesf team 2008, fse-esf mailing list, Nordic ESF Documentation and Nordic Web group; for the Web sites fse-esf.org, openesf.net, openelibrary.info and esf2008.org; and for weekly chat meetings of the ESF Web team. Interviews were carried out during the European Preparatory Meetings. Participant observation was carried out at the *European preparatory Assemblies* and ESF Web team meetings at Lisbon April 2007; Stockholm September 2007; Istanbul December 2007; Berlin February 2008; and, Kiev June 2008.

[2] Online ethnography of English, Italian and Spanish Wikipedia and of the mailing list foundation_l, Wiki-research-l and Wikipedia_l. Participant observation at Wikimedia Italia annual meeting: Rome, September 2007; Meet up Palo Alto November 2008; Wiki meet up Boston October 2009; Ten Days volunteering at Wikimedia Foundation (From 10 to 20 December 2008); Wikimania. Buenos Aires August 2009; and Wikimedia Italia annual meeting at Rome in September 2009.

Distribution of Participation in Content Generation in OCCs

Highly cooperative OCCs are emerging around online media (i.e. Wikis, e-lists, Internet forums). The question is: how is participation organized in such forms of collective action?

Research on the distribution of participation in online communities suggests some common features of the distribution of participation in content generation in online communities. A very low percentage of committed participants usually account for a disproportionately large amount of the content; a low percentage of participants that make very small or indirect contributions; and, finally, a large presence of individuals that do not participate. This distribution of participation is known as 90/9/1 principle or 1% power law (Hill, Hollan, Wroblewski, & McCandless, 1992; Horowitz, 2006; McConnell & Huba, 2006; Nielsen, 1997;). It refers to the general observation that 90% of visitors are lurkers who read or observe but never contribute, 9% who contribute a little or from time to time, and 1% of participants who contribute a lot and account for almost all the content and system activity (Nielsen, 2006).

Lurker is a term that refers to a person who reads discussions and observes an interactive system, but rarely, if ever, posts or participates. However, many lurkers feel that they are part of the community (Nonnecke & Preece, 2000).

Even before the Web was invented researchers documented participation inequality in a variety of online media (Hill, Hollan, Wroblewski & McCandless, 1992; Nielsen, 1997; Whittaker, Terveen, Hill & Cherny, 1998). In a study of more than 2 million messages on Usenet, Whittaker, Terveen, Hill & Cherny found that the most active 3% of posters contributed 25% of the messages, while 27% were from people who posted only a single message (1998). The presence of lurkers was also documented by initial online communities such as the Well (Rheingold, 1993; Turner, 2006). In Free and Open Source projects (FLOSS), a small amount of very active participants are responsible for the vast majority of the work (Ghosh & Prakash 2000; Koch & Schneider, 2002; Mockus, Fielding & Herbsleb, 2002). This behavior in FLOSS is not only specific to source code production, but can generally be found in other elements in software, such as documentation and translation tasks (Robles, Gonzalez-Barahona & Merelo, 2006).

Previous analyses of Wikipedia have addressed the question of participation distribution and showed that contributions to Wikipedia also present strong inequalities. Depending on the research, the importance of a “core team” as the main contributor of most of the content is more or less balanced with the contributions of a long line of less frequent participants. Jimmy Wales, the founder of Wikipedia, originally noted in December 2005 that "half the edits by logged in users belong to just 2.5% of logged in users." (Wales, 2005). Research since 2005, particularly by Kittur, Chi, Pendleton, Suh, & Mytkowic, measuring contribution differently by different classes of editors, showed that elite contributions (10,000 or more edits) were less powerful in comparison with the "long tail" of small participants. The authors put it in this way: “Power of the Few Vs. Wisdom of the Crowd: Wikipedia and the Rise of the Bourgeoisie” (2005). However, Ortega & Gonzalez-Barahona later concluded that less than 10% of the total number of authors are responsible for more than the 90% of the total number of contributions or, in the opposite terms, 90% of the active editors are responsible for less than 10% of the total number of contributions. Ortega & Gonzalez-Barahona's results reduced the importance of the "long tail" and instead reinforced the idea that contributions by the most active participants overwhelm contributions by the crowd of sporadic authors. According to these authors, the evolution of this inequality over time remains very stable (with a typical value of between 80% and 85% of content produced by a core team). Furthermore, all the top-ten languages of Wikipedia showed a similar pattern. A very variable behavior pattern at the very beginning of each Wikipedia (up to 20 months) then altering and showing a common growing trend of inequality, characteristic of mature Wikipedia environments in every language. Finally, these authors also pointed out that the "core team" of very active participants is not necessarily formed by the same individuals over time (2009).

Concerning the openesf.net case, previous research on the social forum has not paid attention to the distribution of participation in the online platforms linked to them. To fill this gap, I analyzed the actual participation at the openesf.net, an online community hosted by the European Social Forum.

Participation at the ESF is organized around both organizations and individuals. However, I analyzed participation in openesf.net in terms of individual participation, since the large majority of the accounts (97,19%) are registered with the name of an individual rather than an organization.

Concerning participation by generating content, the results of the analysis showed that 18 % of the participants generated content and 82 % of the participants did not. Among the participants that did generate content the more frequent contributors are those that generated content for *only* one project (14,2%) while the rest generated content for two to seven projects (3,7%).

The results show that 18% of participants generated content and 82% did not. Within the 18% of content generators, 3,7% were very active participants (generated content in more than one project) and 14,3 % were less active participants. In this regard openesf.net follows an 82/14,3/3,7 rule. Several reasons could underlie the higher percentages at openesf.net as opposed to 90/9/1. On the one hand, openesf.net is not completely open, it requires registration which already indicates a higher commitment to participation. If we consider participation in terms of only visiting the site (without registering) the percentage of active participation would be lower, as the number of participants with lower commitment would increase in contrast to those with higher commitment. On the other hand, participants in openesf.net also meet in organizational meetings and during the ESF itself. The fact that openesf.net participants have other ways of knowing and meeting each other could affect the way people act on the site, for example, it could be the case that it increases participation as some of the participants already know each other.

Furthermore, the results depend on how content is conceived. The generation of content was strictly defined as activities which are not directly related to personal information. Content was understood as the creation of spaces for a project, the editing of wiki pages in the projects and the upload of documents or other audio-visual material in the projects. Instead, if we look at participation in terms of "exhibitionism", that is considering if the participant provides not compulsory information about him/her at the participant page, then the results change. 44,9% of participants provided at least one extra item of information about her/himself in the registration process. In this regard, if we consider providing personal data as content generation, 44,9 % of users would be considered participants. According to Bimber, Flanagin & Stohl one primary effect of NTIs is to make boundaries between private and public domains porous and easily crossed (2005). In this regard, the decision to consider the provision of personal data as content or not must be taken carefully, as it would change the results on the distribution of participation in content generation.

In sum, the tendency to inequality seems to be characteristic of most online communities. However, actual percentages per each profile (active participants/participants/lukers) may not follow the 90/9/1 principle to the letter. Percentages for each profile may depend on what the content is and the protocols for participation in each community. For example, for some communities the percentage of active participants is a bit higher, as will be shown in the following section for the Openesf community case, while in other cases, such as YouTube, only 0.16% of visitors upload content (Source: 90-9-1.com). From this analysis it also emerges that depending on how active content contribution is conceived, results may vary substantially. In order to develop rigorous comparisons of participation at OCCs shared indicators of participation in content generation must be established - which is difficult due to the diversity of content addressed by OCCs.

Organizational Logic of Participation in OCCs

In the previous section, I addressed the distribution of content generation among the participants according to quantitative data on participation. In this section a qualitatively-oriented analysis will be presented instead, in order to approach the organizational logic and main organizational principles of the OCCs' environment. Environment refers to the architecture or structure of the space combined with the social norms and values that regulate it. Additionally, how the several organizational principles relate to each other will form part of the analysis. Finally, reflections on how these organizational principles affect types of participation, and, more concretely, result in the 90/9/1 principle, will also be presented.

My analysis departs from the assumption that collective actions following a representational ethos and collective actions following a participative ethos have their own distinctive logics and dynamics. The meaning and function of participation in a representative organization could be different from participation in an open-to-participation organization. Furthermore, online environments have some constraints that could affect the way participation takes place.

Main organizational principles of participation in OCCs

a) Openness to participation

Openness to participation is the main principle in OCCs. Concrete indicators of the openness to participation dimension are the provision of multi-interactivity channels of participation that allow participation in the content hosted at the site, and the protocols that guide those applications. Protocols refer, for example, to low requirements for credentials to participate. According to Reagle, this open character has a non-discriminatory meaning, and "prohibits arbitrary discrimination against persons, groups, or characteristics not relevant to the community's scope of activity" (2004).

According to the large-N analysis, OCCs usually have an average of 4 different channels of participation (i.e. the possibility to add comments to a specific section of the contents, upload materials, and edit Web pages, among others). The protocols that guide participation in OCCs appear to incentivise participation in a high percentage of the cases (i.e. 80% of the registration systems allow automatic registration without requiring any filter to become part of the platform).

By highlighting the importance of the openness to participation principle in OCCs, I am not implying that all OCCs are equally accessible. OCCs constitute a substantial reduction of the barriers to information and knowledge. However, the level of inclusion of OCCs and the reduction of sources of barriers to participation is not absolute and depends on the issue dealt with. In terms of information usability, the analysis shows that this is an important aspect of the OCCs (all the cases have at least one indicator of usability). However, in other aspects linked to inclusion OCCs perform badly. For example, OCCs turned out not to be inclusive in terms of accessibility for people with physical disabilities. In terms of inclusion by reducing the barriers to use and access the technology which supports the collective action, the OCCs are again irregular. Some OCCs have mechanisms to reduce the barriers linked to the technical base, however 16% of the cases have none.

Although the OCCs are characterized by the importance of openness to participation, the participant observation data showed that equal participation and contributions did not seem to be expected.

While according to the representative ethos, equal participation (understood as equal representations of all voices) constitutes one of the pillars of legitimacy in representative systems, in OCCs, equality seems to refer to the openness for participation (as a possibility) rather than in the resulting participation and contribution.

Finally, it is worth mentioning that openness to participation has a trade off. It does result in disruptive behavior, such as spam or vandalism.

Concerning the case studies, in both of these the indicators for the importance of openness as defined for the large-N analysis are present: that is, both cases adopted easy to use technology and channels for open participation, plus a lack of requirements for credentials or other requirements in order to intervene. However, in contrast to Wikipedia, where a person can intervene in the content without being registered, in openesf the user must register in order to intervene. Registration is however automatic, and so it is not a very high barrier to openness to participation. Furthermore, openesf.net had different degrees of openness. Openesf.net is divided into projects and each project can decide the level of openness for intervening in the project, choosing between: open to any person registered at openesf.net or open only to members of each specific group at openesf.net.

Finally, in the discourses of both cases it is emphasized that the community provides the accessibility to participation. For example, when Wikipedia is presented as "*the encyclopedia that anyone can edit*" (Source: Wikipedia main entrance).

The emphasis on the openness to participation principle impressed in the environment does not necessarily result in actual participation, that is it does not necessarily mean that the OCCs see high participation. If an OCC is participated in or not is a difficult, but overall a relative question. The maximum level of participation depends on the actual goal and target constituency of each case. As will be presented in the following, the openness to participation principle is at the service of the goal or mission of each OCC.

In terms of resulting participation in the case studies, it may be said that Wikipedia achieved a high level of participation in accordance with its goal. As mentioned previously, empirical research showed that 10% of the participants generate 90% of the content (Ortega & Gonzalez-Barahona, 2009). Considering that 10% of the very active participants in Wikipedia number more than 300.000, it can be concluded that Wikipedia is highly participated in (Source, Wikimedia Foundation). More than 300,000 participants is a high level of participation if we compare with other forms of organizing for the achievement of a similar goal, such as the Encyclopedia Britannica (Emigh & Herring, 2005).

Furthermore, the Wikipedia community accomplishes its goal. Wikipedia is the largest encyclopedia in history. There does not seem to be a problem with a lack of participation in Wikipedia. On the contrary, on some occasions a problem of "too much participation" occurs. This happen when the levels of participation are so high that technically the system is not able to sustain the amount of activity and collapses. This occurred for example after the 11 September 2001 attacks or the Obama elections, during which many people wanted to keep Wikipedia updated (Interview Tomasz Finc, Wikimedia Software Developer, San Francisco, November 2009).

Interestingly, from my participant observation, I noticed some signs that suggest that inequality in terms of contributions does not seem to be interpreted as a problem among the Wikipedia participants. GerardM, an active wikipedian, spoke out in an mailing list against the idea of regular equal contributor and for valuing all community forms: “*When you divide people up in groups, when you single out the ones "most valuable" (because they contribute more), you in effect divide the community. (...). When you label groups of people, you divide them and it is exactly the egalitarian aspect (independently of their contribution) that makes the community thrive*” (GerardM e-mail to the mailing list Wiki-research-l 21 October 2008). However, this hypothesis on how Wikipedia interprets the inequality of participation would require further research to be fully analyzed.

Concerning the resulting participation in openesf.net, the picture is less clear. Openesf.net is the first tool based on the open participation principle to actually raise significant participation in the Social Forums. However, the levels of participation at openesf.net are low (less than 1200 registered at the highest point) in contrast with the number of participants in the ESF (between 20,000 and 60,000 people registered at the ESF, depending on the year) (Source, main page of the European Social Forum).

Furthermore, in terms of the interpretation of the inequality of participation in openesf.net, there is a discrepancy among ESF participants. In some of the interviews with ESF participants some resistance to the adoption of open platforms was expressed, because they could increase sources of inequality in participation, while others do not mention this reason or do not consider inequality a problem in itself. So again, more systematic research on this specific question would be required in order to investigate the interpretation of inequality of participation in openesf.net and in OCCs more generally.

b) Participation is possible in multiple forms and to different degrees

Participation is possible in multiple forms and to different degrees. Multiple forms refers to task distribution. Not all participants necessarily fulfill the same tasks, but can choose among several (i.e. adding new content, editing content, classifying content, among others). One person could contribute with non-edited information while another participant takes care of editing it and increasing its quality. Some tasks may require more effort and commitment than others, however, tasks in most of the cases are highly divided, so that each participant can develop just a small part of a module, or a large part of it, facilitating the scaling of the participation.

This must not be confounded with a lack of structure, on the contrary the system is highly structured. The environment is split into modules, which makes it easy to locate information without knowing what occurs on the overall site. Search engines and meta-data systems, which are present in 98% of the cases, allow all the modules to be put together, making them easier to handle.

It may also be worth mentioning another type of participation present, "bots", that is a program developed and controlled by specific participants to execute specific and repeatable acts (such as automatic corrections) which are on some occasions responsible for a large amount of activity.

That participation is possible to different degrees refers to different levels of commitment to the site in terms of time and active task performance. The environment's design allows different availabilities for contributions to be accommodated, which, furthermore, results in the three main profiles of participation: very active or strong, weak and non-participant. Several empirical studies have shown how a mixture of strong and weak ties are crucial for organizational success in social movement organizing (Campbell 2005, p.64; Mansbridge 1986; Morris, 2000, p. 450; Uzzi, 1996).

Very active and committed participants are present. That is, people who have a large degree of commitment to the process and dedicate a great deal of time and a large volume of work or complex effort to it.

The formation of a "critical mass" of active participants is particularly important for starting an online community. In Howard Rheingold's (a proponent of the virtual community) words: "*An online community either gets started or it doesn't. The first important stage is growth, at the very beginning. If you do not have a critical mass of participation – that could be ten* *people! (then the online community doesn't get started). But then you're going to have to scale that so that it's not overwhelming for people.*" (Interview Howard Rheingold, Palo Alto, December 2009).

Sporadic or low level participants are also present. The modular organization and task distribution makes it easy to make only small or weak contributions.

The weak ties enable OCCs to reach populations and audiences that are not accessible via strong ties. That is, people who can contribute only sporadically, but not with high levels of commitment.

At FLOSS, the low level of active commitment required among participants is seen as an advantage (Freeman & Rogers, 2002). Granovetter suggests the importance of weak ties for collective action. Weak ties favor reaching vast and diverse fields of information resources (Granovetter, 2005). The concept of *weak cooperation*, as proposed by Cardon and Aguiton (2007), refers to this characteristic of the relational model of online-based collective action. According to these authors, online cooperation around a common goal generally creates weak links (but a large network) in comparison with offline collective action (Cardon & Aguiton, 2007).

In sum, both strong and weak participation are present and accommodated in OCCs. Weak and strong participation constitute important contributions to the community. Furthermore, non-participation or unintended participation is also present and plays a role.

Non-participation could be characterized as free riding behavior. However, free riding, and in general the fact that a large percentage of people do not contribute, do not necessarily constitute a problem for the achievement of the common goal of OCCs. Free riding constitutes an impediment depending on the good the community aims to build. With exhaustible goods, such as natural resources, which can be "used up" and are costly to extract, free riding constitutes a problem. But in a context where new information and communication technologies have substantially decreased the cost of the reproduction of information, goods-based information, like that provided by OCCs, do not necessarily face scarcity problems. When goods are non-exhaustible, non-competitive and exclusion from their use is costly, then free riding is not necessarily a problem. It is even said that OCCs are anti-rival (Weber, 2006). They are not *only* non-rival in the sense that they can tolerate free riding without reducing their stock of value, but are actually anti-rival in the sense that as a whole OCCS positively benefit from free riders. That is, ironically, the value of the outcome of the OCCs increases when more people use them (Benkler, 2006; Bollier, 2008). This implies that for any participant, whether contributor or "free rider", the mere "use" implies a contribution. Nevertheless, this is only so where there is a sufficient number of contributors.

There are several mechanisms by which the value of a digital commons resulting from OCCs increases as more people "use" it.

Firstly, non-participants contribute due to network effects. When network effects are present, as more people "use" the same product or service the more valuable it is.

Secondly, in online environments most of the actions are translated into digital information, known as *digital threads*, the elaboration of the digital threads are a source of very valuable information to improve the content and environment functioning. It could provide relational and attention data. For example, the environment can learn about the connections between content according to how users navigate across them. Or the number of times an article was visited or downloaded could be used as an indicator of quality.

Thirdly, the non-active participants also play a role as *audience. Free-rider audiences* increase the relevance and value of the site's content and increase the motivations for participation.

Finally, it is also worth considering that even though exclusion is present in OCCs, restricting access to non-participants could be costly.

Concerning the case studies, both Wikipedia and openesf.net are based on a modular and high task distribution architecture. Plus, as presented in the previous section, both at openesf.net and Wikipedia the distinction of strong/weak/non-participants is present.

c) Modularity and decentralized participation

The modular organization of the environment with the splitting of content into separate units (such as articles, software packages, albums of thematic pictures etc.) not only facilitates the presence of several degrees of participation, but also regulates the decentralization of activity, which facilitates the scaling of participation.

Not all participants are involved in all the projects or modules, instead, particularly as the OCCs grow, there is a recurrent tendency for participation to split or fragment into projects or modules.

Empirical research has been carried out on the relationship between centralization and project size in FLOSS. According to Crowston & Howison, centralization scores are negatively correlated with the number of active participants. "In a large project, it is simply not possible for a single individual to be involved in fixing every bug (errors). As projects grow, they have to become more modular, with different people responsible for different modules. In other words, a large project might be an aggregate of smaller projects, resulting in what might be described as a 'shallot-shaped' structure, with layers around multiple centres" (2004, p. 15). In Lanzara & Morner terms: "a characteristic feature of development communities is that the process oddly combines a slow global convergence (among all the participants) on the one hand and short and fast local activity cycles" between a small number of participants on the other (2004, p. 20).

Additionally, distributing the environment between modules favors the scaling of participation. The participation of many people in a single (central) place is more difficult to handle.

The division into projects and the resulting decentralization of the participation is present in both the Wikipedia and the openesf.net cases.

Concerning the Wikipedia case, only very rarely are there occasions which co-involve the entire Wikipedia community. Most of the activities of Wikimedia projects are based on the interaction of small groups. Interviewees even mention a profile of participants “that just write articles in his corner” (Interview Jon Davis, Wikipedian, Berkeley, November 2009).

Concerning the openesf.net case, any participant can be part of all the projects. In fact, 41,5% of the projects are composed by one only member, the rest are composed of 2 to 27 members. The projects with 3 members are the most frequent (20,8%).

The decentralized character of the participation is a significant characteristic of the OCCs. It is significant in its contrasts with, for example, social movement organizing, such the cases of the Social Forums process or the Euromayday (mobilization process around labor precarity in Europe). In traditional social movement organizing, collective action or "doing something together" is conceived of as experiencing moments and places together, such as a decision-making assembly which gathers all the participants. In the case of OCCs, collective action is not a moment or place of "unification", but instead a form of being together in a fragmented or decentralized way.

The decentralized and fragmented character of OCCs opens up the question of what links them. Importantly, collective action is driven by a common mission (as we will see below). However, it is worth mentioning that in terms of the aggregation of the common, decentralized form of the OCCs, also have "trade-offs”. After observing OCCs I began to suspect that the aggregation of the "collective will" (beyond the common mission) become more problematic in this form. Moments which require a collective "voice" in OCCs and which are difficult to achieve with a community form are, for example, decisions on important changes in the site architecture or requirements which arrive from the external world (such as legal questions). However, more research would need to be carried out to confirm these impressions.

AAdditionally, in terms of what links the whole modules, they share the space (the platform) and norms. Furthermore, the use of the same protocols or language links or connects the fragmented or decentralized pieces. In my view, this constitutes lateral forms of aggregations, (more than hierarchical forms or a unification by centralization form) which are essential to the OCCs’ organizational logic.

d) Participation is asynchronous

As presented in the previous section, participation is decentralized and there are few tasks in which all participants are involved, it is very rare that all participants are expected to congregate at the same time.

Members are typically geographically dispersed and the platform is their means of interaction (Kollock, 1999). Furthermore, in OCCs of international scope, the time zones of the participants can be very different, which makes it difficult to meet at the same time.

A moment in which participants congregate at the same time is during physical encounters.

Interestingly, some interviewees said that as more online interaction takes place, there is more need to meet physically.

Asynchronic participation is present in all the cases studies. In the two cases, there are organized "local" meetings among the participants. Plus, both of the case study OCCs hold an annual meeting. For the case of Openesf the annual meeting is much bigger than the online community; while for Wikipedia the opposite is true. Wikimania, the annual meeting of Wikipedia, gathers a small fraction of the community, and from my participant observation, I noticed that those who attended tend to be the more strongly committed. In the case of the ESF, there is also organized synchronized communication through chats.

e) Participation is mission-oriented and methodologically plural

The online frame and the communication possibilities available define the possible organization of the OCCs, and explain some of the organizational choices present, but the issue for analysis in the sector is that the agenda of each OCC also shapes the organizational choices.

Collective action is understood as the pursuit of a goal or set of goals by more than one person. The goal or mission of an OCC is very specific and limited, to build a specific information pool.

I observed that the level of attachment to the mission among each of the different forms and degrees of participation present in the OCCs could be different. That is, there are participants who seem strongly committed, while others do not seem to consider the common mission when they intervene. In this regard, as there are different degrees of participation, there are different degrees in the identification of each individual with the overall mission and goal. Some participants do strongly identify and build an identity as part of the OCC. However, participants do not need to identify with the project as a whole in order to participate. Along the same lines, Stalder argues that the majority of the participants have an individualistic approach to the platform and very few participants have a holistic interest in caring about the dynamic of the whole platform (Transcripts discussion on web communities, Networked Politics Seminar, 2007). In this regard, OCCs are based on a change in the identity building of the individual. From an identity building based on a relationship with big projects, such as political parties or churches, there is a move to the development of a *networked individual identity*, "where individual self-identity – both in terms of the image one has of oneself and the image others have of one - can no longer be separated from one's position within a relational network" (Stalder, 2007; Wellman, 2001).

Furthermore, several empirical researchers have concluded that the motivations to participate in fulfilling the common goal are also very diverse (Benkler, 2006; Weber, 2004). Interestingly, researchers point out how OCCs are able to bring together people with very diverse political orientations (Coleman, 2004; Colleman & Mako, 2004).

However, interdependently of the linkage between the common mission and the individuals, the overall OCC environment, its architecture and its norms, is shaped by the fulfillment of the common mission.

In order to transmit the relevance of the mission in defining the organizational choices it is interesting to compare OCCs with other forms of collective action. For example, in the frame of the global social movement, organizational choices are greatly influenced by methodological ideals (della Porta, 2009), that is, following specific methods (such as decision-making by consensus) is very present in the GJM's organizational choices. In contrast, OCCs are more characterized by choosing methods according to their effectiveness in fulfilling the mission. As a result, OCCs are characterized by methodological pluralism or polymorphism. That is, the coexistence of several working or decision-making styles. That is, there is no one single way to solve all the situations of the site, but a flexible approach that adopts several methods. It could also result in a heterachy between the positions of participants.3 In the famous FLOSS catchphrase, "rough consensus and running code" captures the sense that actions working towards the accomplishment of the mission are more valuable than the use of a precise method. The methodological pluralism of the OCCs might appear as a lack of coherence of the overall system. However, for some researchers, this apparently chaotic diversity becomes a powerful resource for knowledge making and innovation (Brown & Duguid, 1991).

For example, as previously presented, openness to participation is a key principle in OCCs. However, this does not imply that for every task the OCCs must follow the same method developed in a participative way, this may depend on the requirements for fulfilling each aspect.

This mission-oriented principle also implies that the organization follows a logic of accomplishing a collective goal, not a logic of representation of the people involved. This also explains the expectations and evaluations of participation distribution. That is, insofar as a distribution of participation in a 90/9/1 manner does not create an impediment to the accomplishment of the mission, unequal distribution will not be considered a problem.

Finally, it is worth mentioning that, when analyzing OCCs, this methodological pluralism should be recognized, instead of trying to reduce OCCs to just one of their expressions.

Concerning the case studies, Wikipedia's mission reads "Imagine a world in which every single human being can freely share in the sum of all knowledge. That's our commitment" (Source: Wikimedia Foundation main page). In terms of how the mission shapes the expectations of participation, further research might give a more precise and complete picture of the variety of expectations, however, the way in which Sue Gardner, executive director of the Foundation, expresses it is significant: "we need sufficient people to do the work that needs to be done". "But the purpose of the project is not participation".

In terms of polymorphy or methodological pluralism, I observed that in Wikipedia most activity is developed in a form primarily based on open groups on specific articles using consensus decision-making. However the community combines this with a heterogeneous, sometimes secondary options mechanism to force decision-making, block the violation of policies and keep the process within certain margins. For example, on some occasions alternative forms of decision-making such as polls and voting are adopted. Heterogeneous forms refers to hierarchies of administrators and other roles with other privileges, tasks assigned historically to respected individuals and a symbolic leader (the founder).

Concerning the openesf.net case, openesf.net does not have a mission in itself, but is a "tool" for support the working groups in their roles within a much larger process, the ESF, whose goal or motto is that to "change the world is possible" (Source ESF Web site main page).

This lack of a common mission specific to the platform could explain why the methodological pluralism of openesf.net is much more deep and of a different character than seen in the other case. Openesf.net is based on different projects or modules, like the other case. Each of the projects has similar features (e-lists, wiki pages, etc.). However, there is no fixed structure about what has to be done in each of the projects, as is the case for Wikipedia, where what can be done is loosely defined by the architecture of the space and norms. While in the other case methodological pluralism refers to different methods for solving different tasks, in openesf.net methodological pluralism refers to different strategies about what to do in openesf.net.

Each group at openesf.net adapts its use of the site to its own communicational strategies. This makes the incorporation of new participants into the openesf.net projects difficult, as a person must understand what each project is doing in order to be able to contribute. While in Wikipedia, modules share a similar structure, which makes the flow of people and content among them easier.

f) Participation is based on autonomous individuals and volunteers

Participation is autonomous, firstly, in the sense that each person has the autonomy to decide his or her level of commitment and in how he or she wants to contribute on the basis of personal interests, motivations, resources and abilities. The autonomy of participants in driving their actions favors decentralization. The distribution of participation is not based on the centralized planning of the action, but on decentralized, volunteer entrepreneurialism from the participants.

Secondly, participants are volunteers. They do not have a contractual labor relationship with the community, even if some participants may develop their contributions as part of their work outside the community (von Hippel & von Krogh, 2003). As a consequence, each participant assumes the costs of participation (in terms of time, connectivity costs, and education skills, among others), which results in a distribution of costs.

All the cases share these characteristics of autonomous and volunteered participation.

The volunteer character of participation could contribute to the scaling of participation or not: as far as people have the resources required to participate, they will be able to contribute.

The participants are able to contribute according to their own resources of time, skills or money. According to the civic voluntarism model (Verba, Schlozman & Brady, 1995), resources are a key factor in understanding why some people participate whereas others do not. Resource-rich participants with free-time, connectivity, skills and money can contribute more easily than those without such resources, and so the resource-rich tend to be disproportionately represented among participants. In this regard, participation in OCCs could reproduce social and economical inequalities present in society. For example, looking at the gender distribution of participation at the openesf.net shows that only 36 % of active participants are women. While in the case of Wikipedia, previous research concluded that women accounted for 10% to 23% (Ortega, 2010; Glott, Schmidt & Ghosh, 2009).

However, the resource theories applied to OCCs could adapt their analyses to these types of organizational form. OCCs accommodate the different levels of availability and resources of participants. In this regard, it could be useful to apply resource theories according to different degrees of participation (active participation, weak contribution and lurking) - in other words, to analyze if there are systematic differences in distribution according to criteria such as age, gender, time, money or income, physical disabilities and the digital divide along the 90/9/1 principle.

Furthermore, the lack of resources may not be the only explanatory variable. Even people with the necessary resources may decide not to participate for a variety of reasons such as questions of identity or personality. For example, people who identify themselves as creative and/or are more adapted to public exposure may be more likely to participate.

Additionally, the costs (human force) of producing digital commons as assumed by the participants open another perspective for interpreting the sense of participation. Digital commons (partially or totally depending of the case) are accessible to third parties who do not contribute to their production. From this perspective, participation appears not as a "privilege", but as a contribution to society or a "donation".

g) Participation is public and content is publicly accessible

Most OCCs are public. Their public character has to do with external and internal requirements. External here refers to a communicative issue, the goal to spread the contents to the external world. The internal refers to organizational issues.

OCCs provide a public good or service, anyone can access their “outcome”. This public character of the OCCs’ outcomes is also referred to as free or open. The type of ownership of the content in OCCs, regulated by the license, promotes free access.

On some occasions, the type of license also favors the re-use of the content. In such cases, the content can be moved by someone else and it is possible to re-launch the interaction in a different direction. This is known as forking. However, not all the OCCs are based on conditions of forkability. According to the large-N analysis, free licenses over all content are present in 68,1% of the cases. 78 % of the OCCs use FLOSS, which also favors forkability, the remaining 18% use proprietary software.

Secondly, digital commons are developed in public, indeed it would be more accurate to say OCCs *live* in public. In this regard, from the large-N analysis of OCCs it emerged that in 88

% of the cases the content of communications among participants is publicly accessible. That is, it is possible to read the content of communications among participants without registering.

The public, or the transparent, character of the organizational process favors openness to participation. Participants can enter the organizational process without having to fulfill any previous requirement. Public organizing also favors the training of new participants. New participants can see how others perform some tasks. Finally, it also favors the autonomy and decentralization of participation and the coordination of participation without a predefined plan or gatekeeper to distribute roles. Participants can themselves identify where contributions are needed and at what level they wish to get involved.

In the Wikipedia case the whole process is visible to all, not only the resulting content. The channels that host the interaction (such as Wikis, mailing lists, IRC, meet-ups etc) are public by default.

In the case of openesf.net, each project creator may choose how public each project may or may not be. They decide whether the project will be accessible to the general public, only to people registered at openesf.net or only to members of that particular project. However, the majority of the projects have a public character.

h) Participation is implementation

Participation is mainly based on implementing tasks by directly creating or editing content. This is not a major risk. Online interaction facilitates the undoing of actions, and so mistakes are not irreparable. Plus, the content is conceived of as a permanent work in progress.

Participation as implementation is a major characteristic of participation in OCCs. As presented in the mission-oriented principles, the environment is shaped by the accomplishment of a goal, building a digital commons. Participants "build" or "do".

Participation as doing goes beyond participation understood as deliberation. The goal of the participation is not to put together opinions, argue about issues and/or take decisions. To participate is to implement decisions. Deliberation is developed through the doing and undoing of content. There is no separation between decision-making and implementation, nor between a delegation and an implementation body. In this regard, this form of participation goes beyond the principle of participation as it is understood in participative democracy. Participation is not understood as a consultation about a decision to be implemented by public institutions. Instead, participation is engaging in building non-state public services. Furthermore, participation is not a consultation on the use of collective public resources (such as the participative budgeting approach) but, in line with the autonomous character of participation, the participants themselves assume an important part of the costs of the activity.

This form of participation opens up the idea of "doagraphy" or "implementation democracy". Implementation democracy in terms of participation as builders rather than as opinion holders. Doagraphy in terms of who decides on (and assumes the costs of) actions. The logic is not to do with the representation of visions, but the logic of aggregating forces to develop a common goal, where whoever does more has more capacity to "decide". In this sense, it comes closer to the logic of economical democracy (but instead of capital, the key resource is time) than representative democracy.

Concerning the case studies, in Wikipedia, in some cases participants deliberate among themselves before they edit the articles (Viegas, Wattenberg, Kriss & van Ham, 2007). However, even in this cases deliberation among participants is not geared to providing an opinion in a consultation exercise as part of a delegation, but to implementing changes in the platform. Furthermore, Wikipedia forms a “doagracy” in two senses. On the one hand, whoever takes care of a particular part of an article decides about it, including defining the policies that will govern that article. On the other hand, the control of the system is about the ability to bring together forces which will act, more than favoring opinions.

Conclusions

OCCs constitute forms of collective action based on virtual environments that result in the provision of a digital commons.

OCCs share a common pattern regarding the distribution of content contribution. The quantitative analysis of participation in OCCs shows that strong inequalities in contributions among the participants is a characteristic of these types of collective action. The 90/9/1 principle refers to this unequal distribution of contributions, that is 90% of participants lurk or act as an audience, 9% make minor contributions and 1% are very active participants. The exact percentage among these three profiles may depend on the contents and culture of each community. Furthermore, the review of the openesf.net case has shown that the percentage of these three features might depend significantly on how content contribution is conceived. In this regard, the 90/9/1 principle might be adopted as an approximation, while a comparison of participation in OCCs would require the establishment of shared indicators of participation, although the high variability of OCCs makes it difficult to define common indicators.

While much literature has pointed to the unequal distribution of participation, there is a lack of analysis of the main organizational characteristics which could allow us to better understand it. From this analysis it was found that the main organizational principles of OCCs are: a) the environment is open to participation; b) participation has multiple forms and degrees of integration; c) the environment is structured and modular which results in a decentralized but connected participation; d) participation is asynchronous; e) the environment is framed by a common-mission. The methods are shaped by the specific questions to answer, resulting in a methodological pluralism; f) participation is autonomous in the sense that each person decides which level of commitment he or she wants and in what aspects he or she wants to contribute. Plus, participation is voluntary. Participants are not linked by a contractual relationship and participants assume the costs of participation; g) participation is in public, that is, its outcome is available for others and the organizational process is transparent; and h) participation is implementation.

Ecosystemic Participation?

The analysis of the organizational characteristics exhibited by OCCs suggest that they can be usefully regarded as interactive systems (Bateson, 1972; Goffman, 1983; Luhmann, 1995). From this perspective, I propose the concept of ecosystemic participation in order to stress the creating of eco-systemic, feedback and synergistic effects between the diverse forms of participation present inside the OCCs. Furthermore, the term ecosystemic participation highlights the co-dependency and mutual adaptation of the different forms and degrees of participation in order to find an equilibrium between them for the sustainability and effectiveness of the common mission. Organization principles mentioned previously including openness, autonomy, decentralization, transparency and implementation provide the conditions for ecosystemic participation.[3]

With this paper and the proposal of the concept of ecosystemic participation, my aim is to go beyond the mere recognition that the 90/9/1 principle is present in most OCCs; and also to move beyond the "fascination" that causes us to asses why the 90/9/1 principle is also present in many other fields of collective action (such as hyper-links or income distribution). This concept aims to look to how it works, that is, to better understand the functioning and organizational principles of the OCCs which result in the unequal distribution of the participation. More specifically, I look at how they work, rather than looking at the 90, 9, and 1 in isolation, by introducing the interdependency between them into the analysis.

Furthermore, this ecosystemic participation concept is grounded in the deconstruction of the approach to participation as single acts.

On the one hand, I deconstruct the dichotomous approach to participation. The forms of participation in OCCs cannot be reduced to binary schemes. In this line, Bimber, Flanagin and Stohl suggested that recent uses of NTI for collective action challenge the notion that there is a binary choice between participation or not (2005). Ecosystemic participation shifts the focus away from single and unequivocal dimensions (to participate or not participate), towards the development of dynamics in complex cohabitation and the co-evolution of diverse forms and degrees of participation.

Furthermore, these different forms and degrees of participation are integrated, each playing

[3] Finally, ecological or systemic approaches have a variable and long tradition and can be adopted in several senses. In this regard, it might be worth mentioning that the specific sense of the eco-system which I refer to here relates to the "internal" dynamics of the individual participants is each OCC. Other authors, also from an evolutionary perspective, use the ecological approach to refer instead to the interrelations through communication networks among organizations or collective actors in a shared space (Monge and Contractor, 2003; Monge, Heiss and Margolin, 2008; Monge and Poole, 2008; Shumate, Fulk and Monge, 2005; cf. Powell et al., 2005). This must not be confused with the ecological ethics of technology, which refers to the environmental issues related to technology (Maxwell & Miller, 2008). Or ecology media which is a systemic approach to communication that analyses the role that media play in influencing meaning and mind, ways of life and worlds views (Barner & Strate, 2008, p.16).

its own role. In this regard, ecosystemic participation deconstructs the view of unequal participation (through the 90/9/1 principle) into the independent layers of a pyramid. Instead these three degrees 90/9/1 are interdependent. The mechanisms of interdependency between them could change across time and size of the community.

In this line, the different levels of participation (strong participation, weak and non-participation, weak and strong participation) play a role and are integrated and complement each other. Active and committed participants are important to start the online community and assure most of the content; weak participation allows vast and diverse fields of information resources to be reached; and unintended participation improves the system, and as audiences increase, the value and relevance of the content and the participation in the site.

On the other hand, the concept of ecosystemic participation moves away from an analysis of participation as an isolated act to an analysis of participation as an act coordinated with others and the overall collective action. An individual decides his or her role according to the overall stage of participation and acts strategically to fit into the overall equilibrium of the collective action. In this regard, individuals shape the form and degree of their participation according to the overall collective process.

Future Research

Furthermore, I consider the adoption of an ecosystemic participation approach adequate for future research. Ecosystem participation problematizes the analytical and methodological designs centered on framing participation as an isolated individual activity and/or centering analysis on only one of type of participation. For example, it is frequent in the literature for the analysis to focus only on strong participants.[4] In my view, these designs are limited and most importantly inadequate. Instead, I argue that to integrate and consider the different forms and degrees of participation in the research design is appropriate. However, obviously, to integrate an ecosystemic approach in the analysis of participation is clearly a methodological challenge.

Finally, there are several reasons which explain the unequal distribution of content generation and why some people in the online community do not participate. From my analysis, it emerged that, in part, the unequal contributions could be associated to the ecosystemic approach to participation in terms of accommodating and combining several degrees of availabilities for contributions. Additionally, an observation which also emerges from my analysis is that the 90/9/1 principle could be related to a phenomenon of multiple-belonging. The distribution of the participation resources of each individual among the several OCCs he or she could belong to result in the unequal distribution of participation in each OCC. For example, belonging to several groups could explain the weak contribution. A person belonging to several groups could distribute his or her contributions among the groups she or he belongs to. In this line, empirical research on the Global Justice Movement also highlights the multiple-belongings or distribution of activists' participation across groups (della Porta,

[4] Fed by the Habermasian view that speaking out is more valuable than silence.

2004). Multiple-belonging is also present among Wikipedians. According to my interviews, amongst Wikipedians it is common that a person has a “home project” where they concentrate their efforts and then on occasion weakly contribute to other secondary projects (Interview Jon Davis, Wikipedian, Berkeley, November 2008; Interview Betsy Megas, Wikidictionary, Palo Alto, November 2008). Further research, adopting field-level analysis and individual-centered analysis instead of case-centric analysis, is required in order to fully verify this hypothesis.

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Empirical Material Mentioned

Interview Betsy Megas, Wikidictionary and Wikihow, Palo Alto, November 2008

Interview Howard Rheingold, Palo Alto, December 2009

Interview Jon Davis, Wikipedian, Berkeley, November 2009

Interview Rand Montoya, Wikimedia Foundation Head of Community Giving, San Francisco, December 2009

Interview Tomasz Finc, Wikimedia Software Developer, San Francisco, November 2009

Transcripts discussion on web communities, Networked Politics Seminar, 2007

Open Source and the Moral Field of Computing

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Abstract

The concept of “open source”, and “open” more generally, has spread in usage from the world of computing to virtually every domain imaginable: from government and publishing, to academic research, health care and even the military. The usage, appeal, potential and pitfalls of this concept are improved by an understanding of the context in which it emerged: computing in the second half of the twentieth century, initially in the United States but eventually worldwide. In particular, the concept emerged out of a long-running political and moral discourse about rights and obligations among programmers and computer users. This paper presents a framework for understanding the moral culture of the computing field today, situates current open source communities and moral controversies in open source software within this field and suggests some lessons for bringing “open source” into other domains.

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The Open Meme

In the mid-1990s, as part of the "dot-com bubble," open source software achieved notoriety among both those in the technology industry but also among media pundits and technologists. The growth of the internet—and internet commerce—was being powered in large part by an out-of-nowhere free operating system called Linux and a suite of accompanying free software including the Apache web server software and upstart programming languages like Perl and PHP. Rather than relying on expensive servers from companies like Microsoft, new internet companies like Amazon, eBay and Google built their own servers running cheap and flexible open source software and open source software became darlings of the technology and business press. They seemed to be breaking all the rules. Instead of having a corporate bureaucracy overseeing the development of complex software by paid, professional developers, open source software was being developed by a decentralized, unorganized army of volunteer hackers. Instead of keeping their source code—the recipe for building the programs that computer users run on their computers—secret and proprietary, open source projects were giving away their software for free and allowing anyone to modify and redistribute it as they saw fit.

The tech boom went bust, but open source's influence has not waned. Many of the biggest companies in technology—Google, IBM, Apple, Oracle, even Microsoft—now sponsor open source development in one capacity or another. The popular appeal of "open source" has remained as well. In fact, one can find activists, politicians, businesses and commentators pushing for the "open sourcing" of just about every possible domain of social life.

In government, the Obama administration has caught the "open" meme. On election night on CNN, Alex Castellanos lauded Obama as an "open source president," citing hacker Eric Raymond's book on open source software, *The Cathedral and the Bazaar* (Raymond, 2001). Whitehouse.gov now runs on the Drupal open source content management system and Obama created a new Chief Technology Officer tasked with implementing an Open Government Directive to bring "transparency, participation and collaboration" to the White House. The White House isn't alone: the Committe on Homeland Security held a hearing on "Using Open-Source Information Effectively" (Congress, 2005). In 2007, former USAF pilot John Robb wrote a best-selling book classifying the Iraqi insurgency as "open source warfare" (Robb, 2007). Inspired by Washington's newfound receptivity to all things "open," 70 major tech companies (including Google, Novell, Mozilla and Sun) and the Electronic Frontiers Foundation launched the "Open Source for America", which aims not only to "raise awareness in the U.S. Federal Government about the benefits of open source software" but to encourage the "incorporation of open source community dynamics to enable transparency" throughout government. In virtually every other sphere of the social world, one can also find calls to open source: from open source medicine (Woodford, 2004) to open source urban planning (Buskirk, 2009).

But if the "open source" concept is going to be imported into so many different domains of social life, a complete understanding of the open source concept in its source domain, computer programming, is necessary. This is the case not just because of the obvious fact that there's no clear analog for source code in government.[1] The concept of "open source" emerged out of a long-running *political* and *moral* discourse within the computing field on rights and obligations among programmers and users of software. "Open source" is often prefixed to any domain where one wishes to encourage, as the Obama administration put it, "transparency, participation and collaboration." But open source was initially selected, and has thrived, not just because it evokes these values and design principles in software production, but because of the way it fits the social and political culture from which it emerged.

This paper will proceed as follows: First, in the next section, I will sketch out a framework for understanding the moral and political culture of computing. Second, I will provide a historical overview of key events in computing history. Third, I will link together the previous two sections, showing how my proposed framework can be used to understand the changes brought on by the events and developments discussed in the history section. Next, I will sketch out a few other possible applications of this framework, in particular to help us understand the structure of Linux distributions.

The Moral Field of Computing

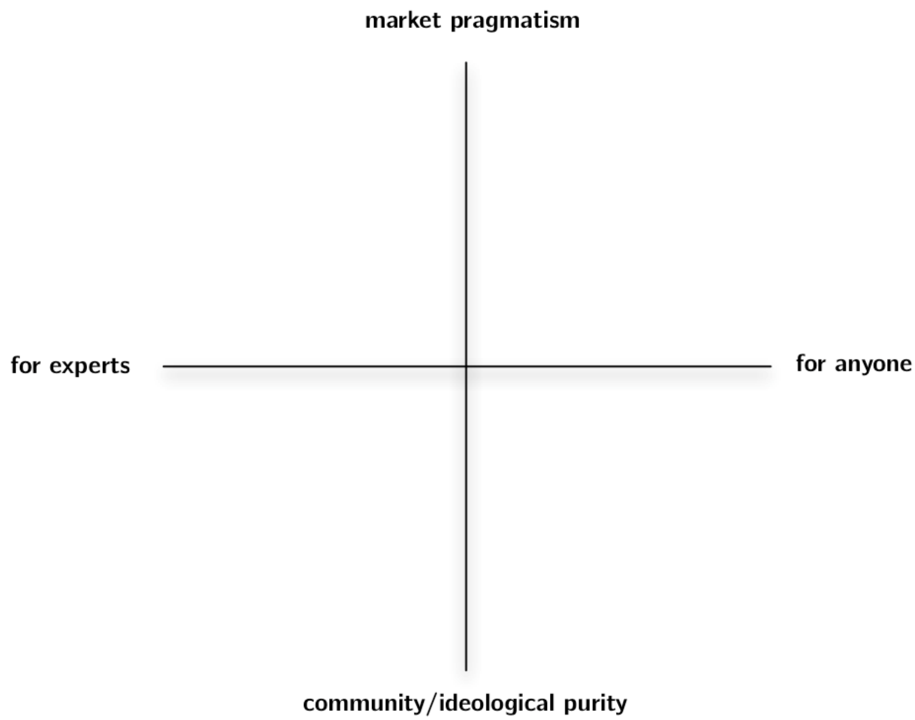
The problem with focusing exclusively on the open source/proprietary divide is that there is a long history of moral and political debate in computing culture that predates these terms and created the context in which "open source" emerged and continues to resonate.

In particular, I argue that the computing field is shaped by both competing moral and ethical visions (an ethic of community vs. an ethic of the market) and competing conceptions of identity and community (a community of experts vs. a community extending to all of humanity). In other words, there are two axes that make up what I will refer to as a moral field of computing. (Figure 1)

My choice of "moral field" here obviously evokes Bourdieu's idea of a field, though I am admittedly somewhat unsure about whether this is correctly classified as an application of Bourdieu's field or not. There are several reasons behind my choice of this label though. First, the spatial metaphor: it's not just that there are two kinds of questions—of community boundaries, of ethical visions—that one can observe animating debate in computing culture, but that these appear to be linked together into specific configurations of how to situate individuals and actors onto a structured, cultural terrain. Second, I argue that this structure is internalized by individuals as a moral and political mapping of actors and events in computing. Participants in the computing field—hackers, corporations, end-users, and so on—position themselves and others on a moral terrain built upon attitudes towards what kind of community is worth building and who counts as a part of that community, and what kind of moral values should guide interaction in that community.

[1]The policy process as source code compiled into law and institutions?

Figure 1: The Moral Field



Open source is best understood within the context of this moral field. The term was chosen, and has succeeded, precisely because it can be adapted to fit the needs and concerns of actors located at multiple points in this field. "Open source" is not a solution to these divisions, but a shared language inside a culture where these debates continue. I will also argue that these ethical divisions and community boundaries that structure the discourse of open source in the computing field are ultimately grounded not in the technical details of writing computer software but in age-old political and moral debates about organizing social behavior. From this point of view, importing the concept of open source into government is not necessarily introducing a bold new idea at all, but is more accurately viewed as re-introducing old ideas back into the political realm, but wrapped in a new technological language.

The rest of this paper will outline the history and structure of the computing field, discuss the role the term "open source", and "open" generally, plays in the field today and suggest some lessons we can draw as we apply the concept of open source and a principle of "openness" to other areas of social life.

Historical Overview

Many books could, and have, been written about the social and cultural history of computing (to name just a few: Levy, 2001/1984; Markoff, 2006; Moody, 2001; Salus, 1994; Weber, 2004). In this section, I will draw on these works to assemble a relatively brief social history of computing. This is not intended to be a complete literature review, nor is it intended as a contribution to scholarly knowledge about these historical events. Instead, the intent is to briefly highlight the key aspects of computing history that I believe are relevant for understanding my argument about the moral field. I acknowledge this is a bit of a hard sell as this section takes up a proportionately large chunk of this paper, and readers already well-versed in this history could safely skim this section while proceeding to the next section. However, I think getting the history right is important, and the details in the section were chosen carefully to highlight what I think are the key ingredients in the political culture of computing in general, and open source in particular.

MIT Hackers

The term "hack" originated in the student culture at MIT. A hack was a playful prank, though a subculture of MIT "hackers" phrase's meaning was elevated beyond the mere prank into a feat "imbued with innovation, style, and technical virtuosity" (Levy, 2001/1984, 23).[2]

In the 1950's, programming involved punching a series of holes in cards, handing those cards off to the only people allowed to be in the room with the computer, certified administrators who came to be known as "The Priesthood," and waiting hours or even days to get the results. Hackers rejected this way of doing things and articulated a "Hands-On Imperative," the belief that one learns about the world by taking things apart and putting them back together (Levy, 2001/1984, 40-46). Hacking was about more than punch cards, it was about interacting with machines, and a group of hackers in MIT's Artificial Intelligence (AI) lab were among the first to develop a hands-on culture of computing.

A "hacker ethic" evolved out of the Hands-On Imperative. Information, necessary for diagnosing problems and making improvements in any type of system, ought to be free. Authority, in particular large bureaucratic authority, was viewed as an obstacle to this free exchange of information. The central nemesis in this war: IBM and its bureaucratized model of computing-by-Priesthood. Early hackers theorized that the giant, inflexible IBM machines were a reflection of the social structure that produced them: rigidly bureaucratic and button-down. Hacking, on the other hand, was about creativity and flexibility. The beloved PDP series of computers in use at the AI Lab embodied this openness and flexibility. Hacking was about meritocracy—your programming skill was the source of all prestige in the community—and programming was not the mindless management of technology, but a source of creativity, art, beauty and, for some, social change and the faith that:

> If *everyone* could interact with computers with the same innocent, productive, creative impulse that hackers did, the Hacker Ethic might spread throughout society like a benevolent ripple, and computers would indeed change the world for the better. (Levy, 2001/1984, 49)

[2] In popular culture, "hacker" has taken on more negative connotations in recent decades. In this paper, hacker refers to the original, positive meaning. For those interested in how these two, contradictory images of hackers came into being, Nissenbaum, 2004 is a good starting point.

The MIT hackers reserved the right of total control over the machines in the AI lab. For instance, when MIT adopted a new multi-user operating system for their computers, the Compatible Time-Sharing System (CTSS), hackers revolted over their distaste for the new system. CTSS required each user to have their own account and password, and administrators limited and charged for access based on time, memory usage and disk space. Where the hacker ethic encouraged openness, CTSS encouraged privacy; where the hacker ethic encouraged Hands-On tinkering that pushed a machine to its limits, time-sharing sequestered users away from the computer at their own terminal and charged them if they spent too much time tinkering (Levy, 2001/1984, 120). The hackers responded by building their own time-sharing system, which they playfully called ITS, or "Incompatible Time-Sharing System." Rather than leveraging the system's multi-user abilities to increase privacy and isolation, ITS built upon a culture of sharing. From the vantage point of today's computer security, the deliberate lack of security in ITS is shocking. ITS users had no passwords and all users could access one another's files. Just as hackers used to look over one another's shoulders prior to time-sharing, ITS included a system of screen sharing where a user at one terminal could have another user's terminal displayed on their own screen. Just as hackers used to have cabinets full of paper tape that anyone could access to learn from the work others had done, ITS users could access the personal files of all other users. ITS was an astonishing collective achievement, assembled piece-by-piece by hackers who sought to instill the hacker ethic into the system. Hacker Don Eastlake described ITS' development like this:

> In general, the ITS system can be said to have been designer implemented and user designed…Features are less likely to turn out to be of low utility if users are their designers and they are less likely to be difficult to use if their designers are their users. (Levy, 2001/1984, 127)

Computing and the Counter-Culture

Levy (2001/1984, 66) identifies an important distinction between "hackers" and "planners" at MIT. For pure hackers, hacking is an end in itself and getting hands-on access to hardware was all that mattered. Planners, however, while often hackers themselves, were also wrapped up in the social applications of technology, "more absorbed by the goals of computing than addicted to the computing process," (Levy, 2001/1984, 66). At MIT, the planners were typified by professors taking an academic interest in the social impact of computers, but on the West Coast hackers more immersed in the counter-culture and social movements of the time and lead the "planner" element of computing culture to take on a more political bent.

The history of computing on the West coast of the United States is interwoven with the early counter-culture (Markoff, 2006). In the 1950s, engineer Myron Stolaroff discovered LSD through membership in a Santa Cruz-based cult-like religious group called the Sequoia Seminar and introduction to Al Hubbard, the "Johnny Appleseed of LSD." Stolaroff became fascinated with the creative potential of mind-altering drugs as an "unprecedented design tool" (Markoff, 2006, 28). Stolaroff recruited fellow engineers at his employer, electronics company Ampex, to begin experimenting with using LSD to enhance their work. This lead to

Stolaroff leaving the company and founding the International Foundation for Advanced Study in Menlo Park, close to Stanford University and technology giants such as Hewlett Packard. Stolaroff used the Foundation to continue his experiments, recruited prominent engineers, scientists and artist from around Silicon Valley. Participants in Stolaroff's experiments included figures such as Stewart Brand, who would go on to found the Whole Earth Catalog, and Doug Englebart, an engineer credited with inventing the mouse and pioneering approaches to human computer interaction still influential today.

Englebart's big idea was that computers could be used for more than raw data processing, to "extend and empower" human intelligence and memory (Markoff, 2006, 46). In the 60's, Englebart's vision would be picked up by a collection of hacker-activists blending the social movements of the time with computing. At the time, the Left was highly suspicious of technology, with the dystopian visions of *1984* and *Brave New World* painting technology as a tool for oppression and surveilance. The liberation-through-technology worldview of the hackers was perceived as naive and dangerous, to the extent that it was perceived at all: at this point, computers were still something only a very small minority of the population experienced hands-on.

Decrying the "excessive purity" of the "technological Jesuits" from MIT (Levy, 2001/1984, 182), a new group of hackers fully immersed in the student culture at Berkeley and Stanford cultivated a more populist, politicized strain of the hacker ethic. A group of Berkeley-area hackers started a tabloid publication and walk-in center, dubbed *People's Computer Company* (PCC). The first issue's cover contained the text, "Computers are mostly used against people instead of for people. Used to control people instead of to FREE them. Time to change all that—we need a…People's Computer Company." An influential book at the time was called *Computer Lib*, whose hand-drawn cover boldly pronounced, "You can and must understand computers NOW" and promoted widespread "computer literacy." The hackers behind the PCC also enacted an ambitious project called "Community Memory": a series of networked terminals around the city that made up the first electronic bulletin board, used for everything from classifieds to sharing poetry and jokes. The PCC and Community Memory were *political* projects, and while their founders were, of course, hackers who loved fiddling with technology, the broader social implications of the technology was a serious motivation behind their efforts:

> [Hackers considered] the computer itself a model for activism, and hope the proliferation of computers to people would, in effect, spread the Hacker Ethic throughout society, giving the people power not only over machines but over political oppressors (Levy, 2001/1984, 181).

Homebrew

Hacker evangelism in the 1970s was aided greatly by technological advancements. The BASIC programming language made programming far easier to learn: it was interactive (i.e. a user typed commands and recieved instant feedback) and its syntax was designed to be more intuitive to English speakers. The plummeting prices of hardware lead to a growing community of "hobbyists," who spent their evenings and weekends scavenging parts stores and soldering together all varieties of gadgetry. With the mid-70s arrival of the Altair, a home computer cheap enough for anyone to buy, hacking took off as a hobby in the mid-70s and California saw the emergence a group whose only rival is MIT's AI Lab in its impact on hacker culture: the Homebrew Computer Club, whose attendees would turn into a who's who of Silicon Valley in the next decade.

The culture of sharing and cooperation that defined the hacker ethic continued at Homebrew. Perhaps the most famous story in hacker history is Bill Gates' "Open Letter to Hobbyists," published in Homebrew newsletter in 1976. Gates, and his upstart company Microsoft, had written a version of the BASIC programming language for the Altair and was selling the software in partnership with MITS, the company behind the Altair. Following the hacker tradition of sharing paper tapes, however, a hacker brought Microsoft's BASIC to a Homebrew meeting and copies were made and circulated. (The only rule at Homebrew: if you take a tape, bring two copies next time to give away to others.) Gates responded by writing a letter:

> As a majority of hobbyists must be aware, most of you steal your software. Hardware must be paid for, but software is something to share. Who cares if the people who worked on it get paid? … Who can afford to do professional work for nothing? What hobbyist can put 3-man years into programming, finding all bugs, documenting his product and distribute for free? The fact is, no one besides us has invested a lot of money in hobby software…Most directly, the thing you do is theft.

Despite the ethic of sharing and aversion to the commercialization of software, Homebrew gradually transitioned from a collection of hobbyists to participants in a thriving young industry: from starting hardware companies selling add-ons for machines like the Altair to building new next-generation machines themselves. For example, Apple cofounder Steve Wozniak would bring prototypes of his early Apples to Homebrew meetings to show off to other hackers and to solicit feedback and advice.

The original activist-planners, who saw technology as a means to human liberation and freedom, were not surprisingly uncomfortable with the encroachment of business into their community. But even the Homebrew hackers themselves—money aside—veered too closely to the exclusive, inward-looking clique that the MIT AI Lab had been. *Computer Lib* author Ted Nelson called the Homebrew attendee's "chip-monks," and Albrecht said, "I could only understand about every fourth word these guys were saying" (Levy, 2001/1984, 220). Homebrew co-founder Fred Moore became disenchanted with the group's "seduction" by technology as well, particularly as the microcomputer industry took off (and people came to Homebrew "with dollar signs in their eyes") and Moore learned of the awful labor conditions under which hardware was being manufactured in Asia (Levy, 2001/1984, 216).

The social landscape we see at both MIT in the 60's and in California in the 70's illustrates a pattern that will continue throughout the next several decades as well: along one axis, tension between pure hackers (less favorably characterized as "chip-monks" or "technological Jesuits") and planners (less favorably characterized as ideologues or politicized hackers), and, along the other axis, the tension between commercial market forces and values and a non-commercial culture of sharing and public goods.

Unix

While hobbyists in the garage were advancing their own populist flavors of the hacker ethic and culture, universities and tech industry research hubs, such as Bell Labs, continued the hacker traditions. The invention and growth of the Unix operating system is a landmark event in the history of computing culture. In 1969, Bell Labs researchers Ken Thompson and Dennis Ritchie were working on an operating system called Multics, but when the project was officially abandoned, Thompson decided to revive the effort, "just for fun," and began work on Unix (Salus, 1994). Unix went on to become arguably the most influential, successful operating system of all time. Forty years later, Unix and its descendants are now running on everything from mainframes to laptops to cell phones.

Thompson and Ritchie built Unix with a specific design philosophy in mind (Salus, 1994; Raymond, 2003). This philosophy was most famously expressed by Douglas McIlroy, a programmer responsible for developing several foundational Unix tools:

> "This is the Unix philosophy. Write programs that do one thing and do it well. Write programs to work together. Write programs to handle text streams, because that is a universal interface."

This may not make much sense to a non-technical audience, but a good way to illustrate this is by way of a comparison with software most academics today are intimately familiar with that is, in many ways, the antithesis of the Unix philosophy: Microsoft Office.

Microsoft Office is a single package of software consisting of a word processor (Word), a spreadsheet application (Excel) presentation software (PowerPoint), and other supporting programs. Each of these applications store their data in their own unique file format: .doc files (Word), .ppt (Powerpoint) and .xls (Excel). Over the years, Microsoft has added many features to Office: a spell checker, a thesaurus, a grammar checker, clip art, multimedia support, a commenting system and "track changes" feature for collaborators, and, of course, an animated paper clip aimed at helping you find your way around these various features. Each of these tools exists only within the Office universe. Everything you might want to do with these files—from editing to printing to spell-checking to merging and converting—all takes place inside Office. To share these files with others, they need the complete Office suite as well (and preferably the same version as you). Office is a monolith. As technology evolves and new features are required of Office (from multimedia support to internet connectivity), these features get tacked on to Office, making it ever-larger and slower, and making its users more and more locked in to the Office ecosystem.

To translate Office into the Unix philosophy would require some heavy redesign.[3] Each of the components—not just Word, Excel and Powerpoint, but the spell checker, searching capabilities, multimedia library, versioning system, etc.—would have to be broken up into their own independent utilities. Instead of being a part of one huge monolith, the utilities would have to communicate with one another.

[3]Regretably, this hasn't been the path taken by most Unix office suites, which have tended to simply clone the functionality of Microsoft Office.

Designing Unix according to these principles—small, focused programs that interact through a universal interface—had social consequences. It facilitated a collaborative, decentralized division of labor from the start. If your program took text streams as its input and resulted in compatible text streams as output, then it could be dropped in seamlessly with the rest of the Unix system. Like its predecessor ITS in the MIT AI Lab, the structure of Unix invited individual tinkering and collaborative, but decentralized, systems design. Again, the social structure developing and maintaining the technological system was inherently linked with the technical design of the system (Weber, 2004).

Unix's spread was also in large part due to an accident of birth: it's founding in Bell Labs (BTL) at the precise time the federal government was taking action against AT&T under the Sherman Antitrust Act. AT&T was forbidden from profiting from sales outside of the telephone, telegraph or "common carrier communications" industry. "Common carrier communications" is a vague phrase open to interpretation, and its shifting interpretation by federal regulators and AT&T lawyers explains much about the history of Unix (Salus, 1994; Weber, 2004, 22). Early on, the phrase was conservatively interpreted and, fearful of commercializing Unix, AT&T decided to license Unix, complete with source code, for a nominal fee. This led to widespread Unix adoption and a growing community of programmers contributing to the platform. AT&T provided no support, so community-based support and development flourished in their absence. Universities adopted Unix and an entire generation of programmers learned programming on Unix and the portability of Unix's source code—written in the C programming language—allowed users to port Unix to a wide range of machines. In short, Unix was, like MIT's ITS and the code shared at Homebrew, "open source" before the "open source software" existed. The technical design of Unix and the social conditions in which it was distributed created a community of user/programmers devoted to the platform. Salus (1994, 143) describes this process:

> Something was created at BTL. It was distributed in source form. A user in the UK created something from it. Another user in California improved on both the original and the UK version. It was distributed to the community at cost. The improved version was incorporated into the next BTL release.
>
> There was no way that Patent and Licensing could control this. And the system got better and more widely used all the time.

By the late 1970's and early 80's, the antitrust environment had changed dramatically and AT&T changed course on commercializing UNIX. After nearly a decade of an open, decentralized development process, this proved to be quite tricky. The University of California, Berkeley, in particular, had become a center of Unix development. In 1975, Ken Thompson took a sabbatical from Bell Labs and spent a year at Berkeley, working with several faculty members and graduate students that were extending Unix in innovative ways, creating tools such as the Pascal programming language and the vi text editor, that became staples of Unix and computer programming. By the late 70's, a graduate student at Berkeley, Bill Joy, was distributing a popular collection of Unix tools and utilities he called BSD ("Berkeley Software Distribution").

When AT&T began commercializing Unix, the collaborative relationship with Berkeley soured. In place of generous, affordable licensing terms, AT&T tightened up Unix licensing: by 1984, official AT&T Unix licenses ran $100,000 or higher (Weber, 2004, 39). Berkeley, whose BSD had transformed from a collection of utilities into a full-blown version of the Unix operating system, spent much of the 1980's carefully stripping AT&T-owned code and replacing it with Berkeley-written code. Unlike AT&T, BSD was distributed for free under an extremely liberal license: essentially, they ask you give credit to Berkeley, but other than that users are free to do whatever they wish with BSD. AT&T and Berkeley became fierce competitors. AT&T owned the Unix trademark and only their version could be called Unix.[4] However, much of the cutting edge development was taking place at Berkeley, who won lucrative DARPA contracts to develop the TCP/IP protocol for BSD, a development which formed the backbone of the internet today.

Consequently, the 1980's saw the Unix world splinter into a variety of incompatible variants of Unix and expensive lawsuits over the Unix trademark and the ownership of Unix code. Universities abandoned Unix as the teaching tool of choice because of AT&T's skyrocketing licensing fees. By this time, another development had shaken the computing world: the personal computer.

The PC Goes Mainstream

In the 1980s and 90s, the personal computer went mainstream for both business and personal use. To the chagrin of the early hackers, however, the "share and share-alike" model of free distribution did not carry over to the early mainstream successes of personal computing such as Apple and Microsoft, who embraced a proprietary model of software development and distribution.

Take Microsoft's Windows operating system, for example. The platform is owned and controlled by Microsoft. The source code for the Windows operating system is maintained internally by Microsoft engineers and is not available for others to view and modify. If you want to develop software for Windows, you'll use the Application Programming Interfaces (API's) developed by Microsoft. If you find a bug or a limitation in these API's, you can submit a report to Microsoft and hope they fix it. When Microsoft releases updates to Windows, you pay Microsoft to get access to the updates. When Microsoft adds a feature to Windows—such as networking or graphics capability—or creates file formats such as Microsoft Word's ".doc" format, they do so in a manner that ensures compatibility with Microsoft software, but nothing else.

[4]Or technically, UNIX, with all capital letters. I'm skipping this convention here simply because it's awkward to type and read, but also because Dennis Ritchie, who created Unix, prefers "Unix" as well: "The difference came because the lawyers decided that all trademarks should be spelled in upper case…Since Unix isn't an acronym, just initial-cap, which I now prefer, seemed more logical. However, one complicating factor was that when we got a phototypesetter, we were so thrilled by it that we thought it was fun to spell UNIX in small caps just to prove we could do it" (Manesh, 2002).

Millions of businesses run Microsoft software on each of their desktop computers and servers. Thirty years ago, almost none of these businesses used computers, but now they all do, and they all bought into the Windows platform when they decided to go digital. They hired support staff trained in supporting the Windows platform, purchased or developed in-house software that runs on the Windows platform, and have employees and customers for whom using a computer means using Windows. For the past decade or so, Microsoft has continued to dominate largely due to the sheer inertia of the Windows platform.

Today there are credible challengers to this platform, but the task is daunting because, as a platform, Windows is not just about Microsoft. The platform also consists of a social network of businesses, software developers and users. The platform confers a set of values, norms, and expectations not just about how software should function technically, but about the kinds of social, financial, even *political* relationships that shape the way the platform is used. Developers outside Microsoft do not have access to the source code and have only indirect input on the direction of the platform. This is not to say this necessarily makes for a bad platform: Windows is arguably the most successful software platform ever, and much great software has been written for the platform. My point is that the Windows platform carries particular kinds of social relationships and cultural expectations that are anathema to the hackers from the MIT AI Lab or the Homebrew Computer Club.

The Free Software Movement

In the early 1980s, MIT AI Lab hacker Richard Stallman had grown frustrated with the increasing commercialization of computing and the restrictive, secretive policies companies were adopting for their code. Stallman believed these developments were not just inconvenient, but were immoral and unjust.

Stallman was widely known for creating the popular Emacs text editor. Emacs began as a collection of macros that allowed a user to customize and add features to the TECO text editor. A community of hackers began using Stallman's macros, improving them and creating their own. Over time, Stallman took the most popular macros and unified them into a single editor, Emacs. Stallman decided to distribute the editor for free, with one condition: contribute any changes made back to Stallman so he could improve the editor, an arrangement Stallman called the "Emacs Commune" (Williams, 2002). Taking the lessons he'd learned from the Emacs Commune and his mentors in the AI Lab, Stallman quit his job at MIT in 1984 and went to work full time on building a completely free implementation of Unix. Following hacker tradition of playful naming, Stallman called his operation system GNU, a recursive acronym for "GNU's Not Unix," poking fun at the fact that Unix was trademarked by AT&T so he couldn't officially call it a "Unix."

Stallman saw the development of proprietary software as antithetical to the hacker ethic, but also immoral, violating not only the scientific ethic of academic computing but also the golden rule (Williams, 2002). The moral nature of Stallman's dissent is clear in his language. The non-disclosure agreements programmers are forced to sign to keep source code secret are "anti-social" and "unethical," making "the first step in using a computer [a] promise not to help your neighbor" (Stallman, 1999). Stallman likes to compare software to cooking, thinking of source code as recipes:

> So imagine what it would be like if recipes were packaged inside black boxes. You couldn't see what ingredients they're using, let alone change them, and imagine if you made a copy for a friend, they would call you a pirate and try to put you in prison for years. That world would create tremendous outrage from all the people who are used to sharing recipes. But that is exactly what the world of proprietary software is like. A world in which common decency towards other people is prohibited or prevented (Stallman, 2001).

Stallman vowed to fight these "fascist advances with every method I could" (Levy, 2001/1984, 419), and is responsible for a series of steps that laid the foundation for today's free/open source ecology: launching the GNU Project, founding the Free Software Foundation, and creating the GNU General Public License. Together these projects promote what Stallman called "Free Software." As we've seen, the notion that code should be freely shared between hackers and that charging for software while keeping source code secret had a long tradition in programming culture, Stallman's contribution was to give this tradition a name, institutionalize the practices of free software and to develop a formal, written philosophy of free software.

The "free" in free software stands for "liberty" or "freedom," not for "without charge." *Libre*, not *gratis*. "Free as in speech, not beer," is a popular expression of this distinction. Stallman articulated the "four freedoms" that any computer user should have with free software. Counting, like a computer programmer, from zero (Free Software Foundation, 2009):

0. The freedom to run the program, for any purpose.

1. The freedom to study how the program works, and adapt it to your needs.

2. The freedom to redistribute copies so you can help your neighbor.

3. The freedom to improve the program, and release your improvements (and modified versions in general) to the public, so that the whole community benefits.

Stallman, and those he recruited to his cause, began to build, piece by piece, a free operating system. And perhaps the most influential thing Stallman would write, however, was not software but a legal document: a software license he dubbed the GNU General Public Licence (GPL). The GPL takes Stallman's four freedoms and wraps them inside a legal license. Whereas copyright is traditionally viewed as a protection for the content producer, the GPL uses copyright for the purpose of protecting the content consumer, a twist Stallman calls the "copyleft." The GPL, to put it as simply as possible, states that a user of GPL'd software has each of the four freedoms outlined above on one condition: that if they redistribute and/or modify the code, they must do so under the GPL or a "compatible license" that grants future users those same freedoms. In other words, like traditional licenses, the GPL places restrictions on what end users can do (they cannot redistribute under a more restrictive license) and grants users privileges (the four freedoms) but the nature and scope of these privileges are radically different than a traditional copyright. Stallman has described the copyleft as “a form of intellectual jujitsu, using the legal system that software hoarders have set up against them” (Williams, 2002). Like the name GNU, the GPL is a “clever hack” of the legal system.

In Stallman, we see a melding of the two hacking traditions: the elite hackers of MIT and the populist, politicized hackers of the PCC era. Like both traditions of hackers, Stallman represents a tension between the “hackers” and the “planners.” No one doubts Stallman’s skill as a hacker, but he emphasizes the social and political aspects of hacking culture in a way his predecessors at MIT resisted. For instance, Stallman makes a point of explaining that he will choose an inferior free program over a technically-superior proprietary application:

> “I think that freedom is more important than mere technical advance…I would always choose a less advanced free program rather than a more advanced non-free program, because I won’t give up my freedom for something like that. My rule is, if I can’t share it with you, I won’t take it” (Stallman, in Williams, 2002, Ch 8).

Stallman has a reputation as a hard-liner with respect to what counts as “free software.” The GPL is the most famous open source license, but in fact, there are several “open source” licenses with different philosophies. The open source license most often contrasted with the GPL is the BSD License, which the University of California adopted for it’s BSD distribution of Unix. The BSD license is, in one sense, “more free” than the GPL in that it places very few restrictions on users: do whatever you want with the software, just make sure to include credit to the University of California. So companies can take BSD-licensed code, make modifications and release the result under any license they want. Apple’s proprietary Unix operating system, Mac OS X, for example, is built on top of BSD Unix.

Stallman does not see this as “more free” however. For example, the X Windows system, the software that allows Unix systems to draw graphical windows on the screen like Microsoft Windows or Apple’s operating systems, was developed at MIT and released under the MIT license, which, like the BSD license, is extremely permissive. The result was X Windows being incorporated into proprietary Unixes without the source being made available. Stallman argues:

> The developers of the X Window System did not consider this a problem—they expected and intended this to happen. Their goal was not freedom, just “success,” defined as “having many users.” They did not care whether these users had freedom, only that they should be numerous (Stallman, 1999).

Linux

In the early 1990’s, the Unix world was a relatively bleak place compared to the rest of the computing industry. PC’s were starting to take off, and Microsoft’s Windows operating system was dominating both the growing business and consumer markets. While Microsoft was cleaning up, competing Unix vendors were busy taking legal action against one another and building proprietary elements into their own flavors of Unix, creating a mess of incompatible Unix systems. Berkeley's BSD Unix, despite years of rewriting from scratch to remove any proprietary code, was tangled up in lawsuits as well. Stallman's GNU Project had successfully produced many components of the GNU operating system, but had yet to complete the GNU kernel, which as the name suggests, is at the core of the operating system, interfacing between the computer's hardware and the other components of the system.

In the 1990s, the free operating system would find it's kernel at last, but it would not come from Stallman and the GNU project, but from Finnish student, Linus Torvalds. Torvalds simply wanted to be able to follow his email and newsgroups from the comfort of his dorm room during the cold Helsinki winters. So he decided to build his own version of Unix to run on his personal computer. Like Ken Thompson two decades earlier, Torvalds began this project "just for fun," as he would title his autobiography (Torvalds, 2001). However, whereas Unix spread slowly over the course of a decade via the passing of tapes between a handful of Universities with computers, Linus's Unix (which would become "Linux" for short) came into being right as the internet was coming into its own.

In 1991, Torvalds announced his new project on the mailing list of an education-based Unix variant, Minix, and shortly thereafter posted version 0.01 on a public ftp server and it quickly gathered steam. The initial versions of Linux were licensed under terms Torvalds crafted himself, but he switched Linux to the GPL relatively quickly. Fearful of commercializing Linux, but wanting to make accomodate certain kinds of commercial transactions, the GPL was an attractive option. Additionally, Linus admits some loyalty to the GNU project, early on:

> The fact is, to make Linux usable, I had relied on a lot of tools that had been distributed freely over the Internet—I had hoisted myself up on the shoulders of giants. The most important of these free software projects was the GCC compiler (GNU C Compiler). It had been copyrighted under the General Public License…Under the terms of the GPL, money is not the issue. You can charge a million bucks if somebody's willing to pay it, but you have to make the sources available. And the person you give or sell the source to has to have all the rights you have. It's a brilliant device (Torvalds, 2001, 95-6).

In 1991, Torvalds had attended a talk by Stallman at the University of Helsinki. From the beginning the practical benefits of the GPL were obvious to him, but not the political bent of Stallman and the GNU project:

> Judging from the fact that I don't remember much about the talk back in 1991, it probably didn't make a huge impact on my life at that point. I was interested in the technology, not the politics (Torvalds, 2001, 58).
>
> […]
>
> Richard Stallman wants to make everything open source. To him, it's a political struggle, and he wants to use the GPL as a way to drive open source. He sees no other alternative. The truth is, I didn't open source Linux for such lofty reasons. I wanted

> feedback. And it's how things were done in the early days of computers, when most of the work was done at universities or defense establishments and they ended up being very open (Torvalds, 2001, 194).

In just a few short years, Linux would go from being a fun side-project starting in a Helsinki dorm room to a full-fledged operating system competing with the Microsoft's and IBM's of the world. The social structure and norms that guided this quick development echo the history of hacker culture.

In the language of the MIT hackers, Torvalds was emphatically not a planner. Linux was not a platform to test groundbreaking ideas in computer science. Rather the overarching goal was digging in and making things work: "Make it work first, then make it better" (Moody, 2001, 80). Two quick examples of key early design decisions illustrate this example.

First, without going into technical detail, there are basically two routes towards developing an operating system kernel, a "monolithic kernel" and a "micro-kernel." Suffice to say that a monolithic design is more common and traditional and a micro-kernel design is an improved, more elegant, more efficient—and more academically interesting—way to design a kernel. Micro-kernels have also proved much harder to produce. GNU's failure to produce a free kernel is often attributed to Stallman's decision to produce a micro-kernel. Torvalds opted for a monolithic kernel simply because he knew they could make it work. Andrew Tanenbaum, creator of the Minix operating system Torvalds drew early inspiration from, was scathing in his critique of this decision, calling it a "giant step back into the 1970's" and pronouncing Linux "obsolete" (Moody, 2001, 50). Torvalds' response:

> From a theoretical (and aesthetical) standpoint, linux loses. If the GNU kernel had been ready last spring, I'd not have bothered to even start my project: the fact is that it wasn't and still isn't. Linux wins heavily on the points of being available now.

A second case illustrating this "make it work first" principle was the addition of networking code to the kernel in 1992. At the time, the lead developer on the networking code was trying hard to implement a new, improved approach to networking that was taking an excessive amount of time. Because of user impatience with the lack of networking, Linus approved a separate track for networking development aiming to just "make it work first." The lead developer on this second project, British hacker Alan Cox, fast became Linus' "Number 2" and the initial networking approach was abandoned.

The networking example illustrates another key component of the social structure of Linux: Linus has final control over the kernel, but early on began delegating responsibility for specific components of the kernel to a group of trusted "lieutenants." The technical design of Linux mirrors this social structure: it is a modular design, enabling developers to work within the space of their own kernel modules that fit together to form a functioning end product. As Linux became more and more popular, the bug reports from users, and proposed patches from developers, increased in volume as well. In the first few years of Linux's life, Linus frequently released major updates just days apart, incorporating bug fixes and feature improvements submitted by contributors from around the globe and vetted by his trusted circle of lieutenants.

This social structure continues today. For example, the log for Linus' kernel tree is publicly available at git.kernel.org: you can check it out at any time, compile it, make changes to it or study it. Or, if you're not quite up to kernel hacking, you can at least get a revealing history of work on the kernel. Table 1 contains a snippet from the source control logs of the kernel. This is the most recent activity on Linus' kernel tree at the time of writing (Saturday, April 11, 2009, with version 2.6.30 of the kernel nearing release).

Table 1: Linus' Kernel Tree Log, April 11, 2009

Time	Author	Description	Commit
20 hours ago	Linus Torvalds	Merge git://git./linux/kernel/git/dhowells/linux-2... [master]	d848223
22 hours ago	Linus Torvalds	Merge git://git./linux/kernel/git/dhowells/linux-2...	5de4c51
23 hours ago	David Howells	Separate out the proc- and unit-specific header directo...	2f2a213
24 hours ago	David Howells	Move arch headers from include/asm-mn10300/ to arch...	da76166
36 hours ago	David Howells	FRV: Move to arch/frv/include/asm/	e69cc92
36 hours ago	David Howells	FRV: Fix indentation errors to keep git-am happy when...	1879346
37 hours ago	Linus Torvalds	Merge git://git./linux/kernel/git/bart/ide-2.6	6594d0b
37 hours ago	Linus Torvalds	Merge branch 'for-linus' of git://git./linux/kernel...	0534c8c
37 hours ago	Linus Torvalds	Merge branch 'for_linus' of git://git./linux/kernel...	54f93b7
37 hours ago	Masami Hiramatsu	x86: fix set_fixmap to use phys_addr_t	3b3809a
43 hours ago	David Howells	MN10300: Kill MN10300's own profiling Kconfig	62b8e68
43 hours ago	David Howells	FRV: Use <asm-generic/pgtable.h> in NOMMU mode	6fde836
43 hours ago	David Howells	keys: Handle there being no fallback destination keyrin...	34574dd
43 hours ago	Stoyan Gaydarov	afs: BUG to BUG_ON changes	11ff5f6
43 hours ago	Linus Torvalds	Merge branch 'x86-fixes-for-linus' of git://git./linux...	e66dd19
43 hours ago	Linus Torvalds	Merge branch 'tracing-fixes-for-linus' of git://git...	c2ea122

Each line in Table 1 represents a "commit," the name for when a modification is accepted into the code base. Of course, the specific content of each of these commits isn't important to us here, but two other things are. First, the first column shows the time of the commit relative to when I retrieved it, and, as you can, development is fast and furious, even today as Linux is a relatively stable, mature product. Second, you can see that Linus is not the author on all of these changes. In fact, if you read the description of each commit attributed to Linus, they all actually show Linus merging changes made by others into his own branch of the kernel. Other kernel contributors push changes to Linus which he accepts, rejects or modifies himself.

At the time, Linus' willingness to to delegate flew in the face of traditional theories of software development. Andrew Tanenbaum was critical of this as well:

> During the 1970s, when structured programming was introduced, Harlan Mills pointed out that the programming team should be organized like a surgical team—one surgeon and his or her assistants, not like a hog butchering team—give everybody an axe and let

> them chop away…I think coordinating 1,000 [software] prima donnas living all over the world will be as easy as herding cats. (Moody, 2001, 78)

In addition to the challenge in "herding cats," Linux faces a constant threat: forking. A software "fork" is one developer or group of developers takes the existing code base for a piece of software and starts their own, independent development track rather than contributing their code back to the initial project. The GPL guarantees the "freedom to fork," yet Linux has managed to avoid this fate. By incorporating the strongest candidates to lead forking projects into Linux as "lieutenants," and by consistently making progress on improving the kernel instead of chasing academic dead-ends, Linus has developed a loyal following many open source projects lack. Disagreement among BSD developers, for example, has lead to several separate BSDs: NetBSD, FreeBSD, OpenBD and others.

Eric S. Raymond, who describes himself as the anthropologist of the open source movement, wrote an influential essay, *The Cathedral and the Bazaar*, contrasting the Linux development style with traditional software development:

> I believed that the most important software (operating systems and really large tools like the Emacs programming editor) needed to be built like cathedrals, carefully crafted by individual wizards or small bands of mages working in splendid isolation, with no beta to be released before its time.
>
> Linus Torvalds's style of development—release early and often, delegate everything you can, be open to the point of promiscuity—came as a surprise. No quiet, reverent cathedral-building here—rather, the Linux community seemed to resemble a great babbling bazaar of differing agendas and approaches (aptly symbolized by the Linux archive sites, who'd take submissions from anyone) out of which a coherent and stable system could seemingly emerge only by a succession of miracles. (Raymond, 2001)

"Free Software" vs. "Open Source"

The internet was crucial to the development of Linux, which appeared on the scene just as the internet was becoming widely available to computer programmers around the globe. As the internet expanded from a relatively obscure resource for academics and the technical elite into a central component of our economy and our public culture, Linux was again in the right place at the right time. In the early days of the web, two companies competed in the web server market, Netscape and Microsoft, both offering their own proprietary systems. However, a third option, the free, open source Apache web server, would soon take off as the web server of choice, carrying Linux along with it. Linux servers were not only cheaper, but also faster, more reliable and, thanks to being open source, more flexible for the upstart web market. Virtually all of superstars of the online economy—Google, Amazon, Yahoo, eBay and more—built their businesses on Linux, the Apache web server, and a collection of other open source tools like the Sendmail email server software and scripting languages such as Perl and PHP.

However, Linux faced a credibility problem with businesses. On the one hand, IT managers ought to rejoice at a free alternative to the expensive systems available at the time. But how could the “free” software, built by a rag-tag bunch of hobbyists, possibly be as good as the software written, and supported, by a respected, successful corporation like Microsoft? Additionally, for fledgling businesses built around free software, how can one expect venture capitalists, looking to make a profit off their investments, to fund something that is “free.” Of course, this is not what the “free” in “free software” means—it means “free as in speech,” or *libre*, not “free as in beer,” or *gratis*, but this isn’t a distinction an outsider can easily pick up on right away. Complicating things was the fact that “Freeware” frequently referred to software that was gratis but not libre: software distributed for no charge, but with proprietary, secret source code.

To address some of these questions, Tim O’Reilly (founder of O’Reilly Media, a technology book publisher) organized a “Freeware Summit,” assembling a who’s who of free software project leaders at the time—with one notable exception: Richard Stallman, who O’Reilly felt would “disrupt the effort to achieve a consensus” (Moody, 2001, 167). The group decided they needed to agree upon a name if they were going to maximize their collective chance at business success, and after putting several options to a vote, “open source” was selected. The group decided that the crucial component was the sharing of source code. “Free software” got “almost no positive votes” (van Rossum, 1998).

Stallman interpreted this as treason against the GNU mission: “free software” is fundamentally about a ethical, moral belief that proprietary software is a threat to human liberty and equality. “Open source” drained this of it’s moral content in Stallman’s view, leaving only a argument about the practical benefits of sharing source code. When asked a question about “open source,” Stallman always retorts, “I do free software. Open source is a different movement” (Williams, 2002).

From here on, I will refer this debate between “free” and “open source” software as the “FLOSS Discourse,” FLOSS being an acronym for *Free Libre Open Source Software*, one of several acronyms commonly used to represent the entire community. While “open source” has won in popularity, and the debate between “free” and “open source” factions has cooled a bit in recent years (if not from Stallman himself: see Moon, 2007, for example), the labels remain problematic, forcing people to concoct weird acronyms like FLOSS to embrace the entire field of non-proprietary software. The division also illustrates the difficulty in chopping up the computing world into just two camps: “open source” and “proprietary.”

The distinction is made even more tricky by the fact that open source software has become big business since the days Linus Torvalds started Linux in his dorm room. Large corporations like IBM, Google, Apple and Oracle are among the biggest contributors to open source projects. Businesses have embraced open source software for a variety of reasons. Some companies that produce open source software, such as Red Hat, who produces the Red Hat Linux distribution, have a business model where they give away their software for free, but make money by charging businesses for support. For the bigger companies, such as Google, though, investing in open source software is a smart investment in infrastructure. Google is not really a software company: they sell advertising based on an online search service they run. Open source software underlies much of the technology they use to this end, and they want to have the best engineers capable of bending this software to Google's will.

The Moral Field and Computing History

Throughout the history in the previous section, I've identified two axes along which conflicts tend to occur: one involving competing models of community, another involving competing ethics with respect to the role of the market and private enterprise.

First, there is a history of tension between visions of an exclusive community of experts and visions of an inclusive community for everybody. Programming is an expert culture: one must acquire technical and difficult knowledge and the skills necessary to mobilize that knowledge. Status within the community of programmers is, at least ideally, based on technical merit and competence, and programmers frequently describe themselves as artisans or craftsmen. However, computers have always attracted those with a belief that technology can be a vehicle for empowering ordinary people, not just those comfortable learning C or playing with a soldering iron and a circuit board. "Computing for the People" vs. "showing off at Homebrew." "Planners" vs. "Chip-monks."

Second, there is a history of tension between communal values and practices and commercial values and practices. Student hackers at MIT cultivated a hacker ethic in direct opposition to the commercial, bureaucratic IBM. The increasing presence of Silicon Valley technology companies at Homebrew caused controversy among Homebrew participants. Unix was created "just for fun" by Ken Thompson and Dennis Ritchie and developed a thriving, active developer community in the 1970's despite—even because of—AT&T's lack of interest in commercializing Unix. In 1984, Richard Stallman started the GNU project out of the belief that computer code ought to be free and not owned and controlled by private companies.

Figure 2: Historical Timeline

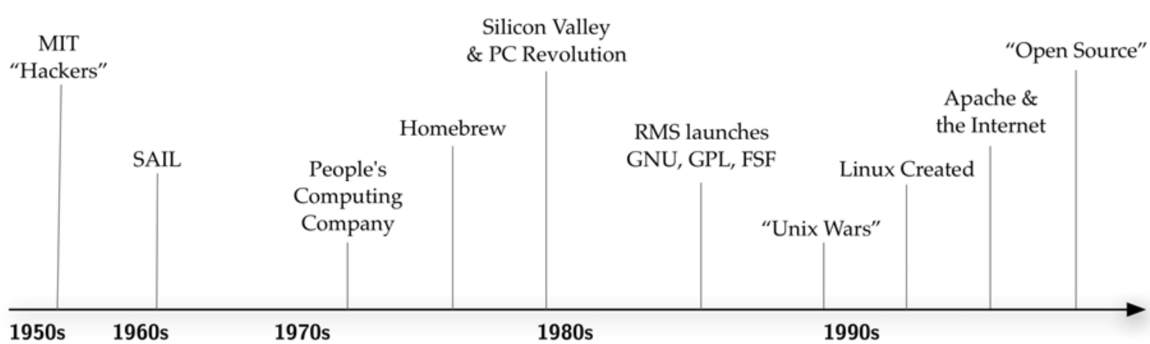
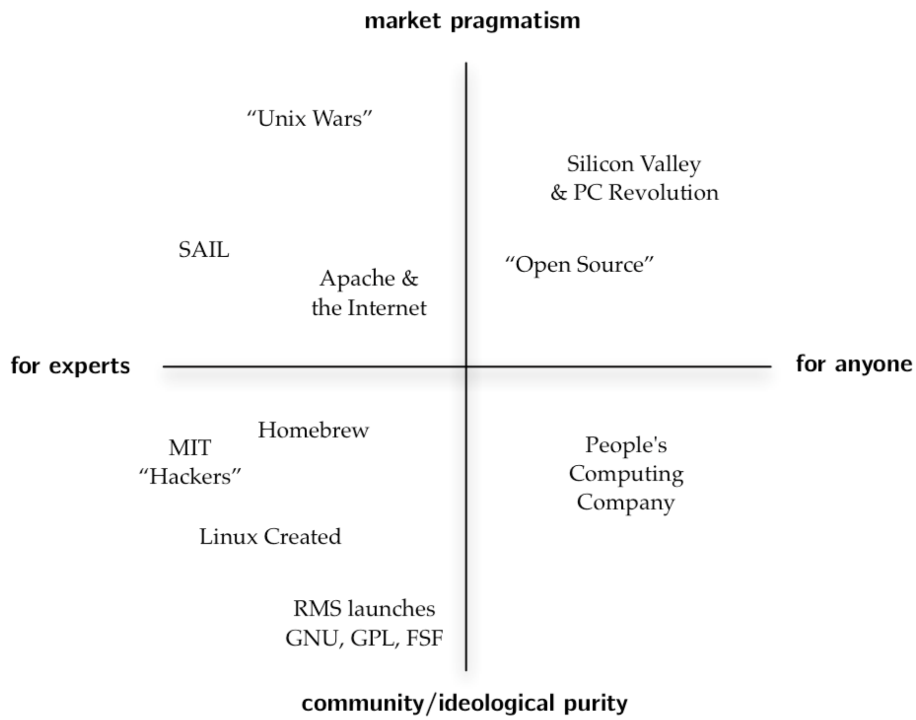


Figure 3: Computing History and the Moral Field



To illustrate this, a timeline of the key events in computing history reviewed in this chapter is presented in Figure 2. Each of these key events is then mapped onto the moral field I introduced earlier in Figure 3. Figure 3 represents the moral and cultural field of computing, which is structured by the two concurrent debates between visions of community and the market, on the one hand, and visions of an expert culture and a liberatory "computing for the people" on the other. The key events in computing history can each be described in terms of their impact & position within this field. The MIT Hackers' rebellion against IBM and corporate bureaucracy in favor of a tightknit group of elite hackers represent a shift towards the lower-left quadrant of the field. The "People's Computing Company" pulled activity away from a tighknit group of "chip-monks" into the lower-right quadrant, taking the community-model of computing culture to the masses. The "Unix Wars" of the late 1980s taking Unix out of it's community roots and into a environment of competing, proprietary, big business-oriented vendors and Unix-based OSes shifted activity upwards into the upper-left quadrant. The PC revolution and Microsoft's mission of a "PC on every desktop and in every home" took the pro-market, proprietary model of computing to the masses in the upper-right quadrant.

The term "open source" was coined and has thrived in this context. In Figure 3, I've positioned the adoption of the open source label in the "market pragmatism/for anyone" quadrant because the term originated as an attempt to make free software more palatable and more understandable to an outside audience, particularly outside businesses. For experts interested in the technical details of the software, it conveys the crucial bit of information: they can get at the source code and play with it. For non-programmers, open source becomes a kind of ethical consumption cause—rejecting software created by power-hungry corporations who want to hold you hostage by locking you into their software and by infringing on the rights of their workforce. Earlier I said that Stallman believes that open source is free software drained of the moral cause, but this isn't quite right: open source, even in its most business-friendly guise, does engage a range of moral positions about the value of particular kinds of human organization and motivations. Adherents to an ethic of business see a parallel between free, open markets and open source software, while adherents to an ethic of community see open source as consistent with an inclusive, democratic culture. Of course, people can believe in both of these things: that free markets are good and that making money is a worthwhile goal, and that building transparent and participatory communities are admirable goals as well. But as scholars of political culture and philosophy know well, these values can also come into frequent conflict with one another.

To bring this historically-informed argument into the present, I'm going to turn to another brief example: Linux Distributions.

Linux Distros and the Moral Field

Technically, Linux is just a kernel, but when someone says they're "running Linux" on their computer, they're usually referring not just to the kernel itself, but to an entire system made up of hundreds of packages pulled from from hundreds of sources. While in principle, anyone can download the source code to the Linux kernel and these hundreds of associated open source tools and build a complete working Linux system, in practice this doesn't happen very often. Nearly everyone, Torvalds now included, uses a Linux "distribution" these days. Distributions vary, and I'll discuss distributions in more depth shortly, but in general, all Linux distributions include pretty much the same software. This includes the Linux kernel and the GNU tools developed by Stallman's GNU Project, but your standard Linux distro today includes much more software than Linux plus the GNU packages. To name just a few popular packages:

- The Firefox web browser and Thunderbird email client (Mozilla Corporation).
- OpenOffice.org office suite (Sun Microsystems).
- Apache web server (Apache Software Foundation).
- Either the X.Org or XFree86 implementation of the X Windows system.
- A "Desktop environment" such as GNOME (part of the GNU Project) or the German-based KDE. (Unlike Windows or Mac OS X, where Apple or Microsoft determine the "look and feel" of the interface (windows, dialog boxes, buttons, menus, etc.) for all versions of the OS, there's a wide range of interfaces for Linux. There are many

"desktop environments" that manipulate the appearance and behavior of the interface and provide competing visions of what Linux should look like.)

- The Vim text editor ("charityware" maintained by Bram Moolenaar).

- A variety of programming languages these and other popular applications are built upon (Ruby, Python, Perl, PHP and more).

- Samba, software that lets Linux computers communicate with Windows networks

- CUPS (Common Unix Printing System), which allows a computer to act as a print server on a network (Owned by Apple).

Because no one entity owns the exclusive right to distribute Linux, one can choose from various distributions managed by a wide range of individuals, organizations, businesses, and even governments.[5] This practice of building a usable, out-of-the-box Linux system was among the first business opportunities to arise from Linux.

Despite the fact that anyone can start a new distribution at any time, the world of Linux distributions has proven relatively stable. While some early distributions have gone away, several of the early "distros" are still around today, with each major distro tending to fill a particular niche within the distribution market. Debian, for example, was one of the first distributions that attempted to bring the distributed, online development model of Linux to the distribution as a whole. Debian pioneered a system that broke the components of the operating system into "packages" and delegating responsibility for maintaining individual packages across a massive group of volunteers coordinated over the internet. When a user installs Debian, they pick and choose from a vast collection of packages that all plug right into the Debian system. Red Hat is an another early distribution that survives to this day as the leading distribution for business use.

Distributions play much more than a merely technical role though. In the Linux world, distributions are arguably the central units of social organization and identity. One of the first steps one takes in becoming a Linux user is choosing a distribution. In many respects, this is often an arbitrary decision: all Linux distributions include more or less the same software packages and look and feel more or less the same. The distribution simply does the hard work of pulling together the disparate packages that make up "Linux" and making them work with one another so the end user has less work to do when setting up their system. However, picking a distribution is important as much for social reasons as for technological reasons. Distributions are the hub of community activity for many programmers, but particularly for end users. Because the support model for much open source software is "search the forums and ask for help," one chooses a community as much as they choose software.

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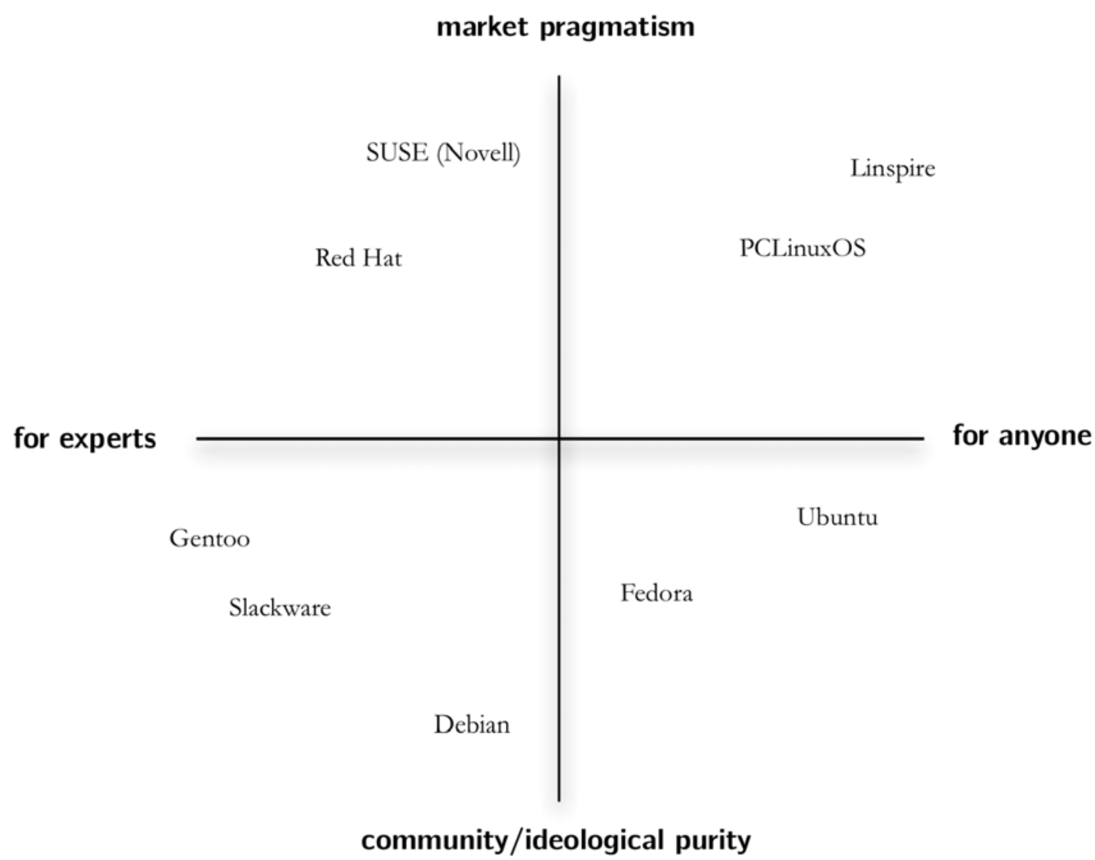
[5]In February 2009, the Cuban government launched their own Linux distribution for use on all government computers. The distribution, called Nova, is based on the Gentoo Linux distribution. Russia is reportedly developing its own distro as well.

Linux distributions and their communities, I will argue, situate themselves within the social computing field I introduced above. Figure 4 places Linux distributions within this framework.

Figure 4: The Moral Field of Linux Distributions



One's choice of distribution communicates to other Linux users the kind of Linux user one is. Some Linux distributions are geared towards highly technical users who enjoy compiling their software from source and having a completely customized system (such as Gentoo). Other distributions aim to be "Linux for Humans" (Ubuntu's motto) and seek to provide a desktop experience that is easy enough for Grandma. Some distributions (such as Red Hat and Novell's SUSE) strive to serve the enterprise market, putting Linux on servers and desktop computers inside businesses. Other distributions (such as Debian) have a strong non-commercial community mission and a commitment to the free software ideal. Other distributions aim to be more "user-friendly" by adopting the business and support model of traditional proprietary OS vendors (Linspire), while others, like Ubuntu, attempt to bring the community software ethos to the masses.

The label "open source," and the "free software" challenges to its legitimacy, are mobilized in the distinctions between these distributions and their communities. Some advocates of a Linux for the masses view the inclusion of and interoperability with proprietary software as an acceptable end to work towards. For example, Linux distributions differ in whether they distribute non-free media codecs, such as the software necessary to play mp3 files, a non-free format, or the proprietary drivers to some graphics cards. Some distros include these pieces of software by default, arguing it's a necessary evil in order for Linux to reach a mass audience, while others make the user install these themselves, often with a stern warning (see Figure 5). The most prominent contributors to FLOSS projects today include employees of companies like Google or Oracle, whose job responsibilities include writing free code that will be given away to anybody, including competitors. However, the dedicated defenders of Free Software purity today are not limited to bearded Unix programmers who speak in regular expressions, but often includes non-technical Ubuntu users who switched to Linux (or *GNU/Linux*) out of political opposition to the tactics of proprietary software companies like Microsoft or Apple. Other devoted Linux users and programmers could care less: the ideological debates are just a distraction from the source code itself.

Figure 5: Installing Media Codecs in Ubuntu

The case of Linux distributions is just one case where we can see a field structured according to the dynamics of competing ethics and models of community. This paper is part of a larger project that, in addition to looking at the culture of Linux distributions in greater detail than presented here, is also exploring how other computing platforms today—from web applications and platforms like WordPress or Twitter, to mobile platforms like Apple's iPhone and Google Android—are shaped by the history of computing culture and are engaging with this culture today.

Wrapping Up

I began this paper by claiming there is value in contextualizing "open source" within the larger field of computing before we haphazardly import the concept into everything from medicine to urban planning and government.

There is more to open source than a vague commitment to "transparency, participation and collaboration" or just its literal meaning alone (that you can view and modify the source code). There is also more for scholars of politics and social behavior to learn from open source than just specific organizational principles or legal strategies, both of which are significant and well-covered by current research and literature. Computing culture has a tradition of free, open and contentious deliberation about the rights and responsibilites shared by members of a community. Understanding the political culture of computing requires more than just an appreciation of the distinction between open source and proprietary, but of the ways in which actors situate themselves and others according to positions taken on questions of community boundaries and ethical worldviews. Open source is not "the political part" of the software world, but rather an entree into an entire domain of social life—with corporations and hobbyists, experts and activists—shot through with political and moral tension and deliberation.

In other words, the "politics of open source" is bigger than just open source, and there is more than a novel and innovative method of software development going on here. In addition to organizational, technological and legal innovations in the computing sphere, there is a distinctive, complex moral and political culture that ought to be of interest, even to scholars who currently are unaware of what's going on in open source and computing, and ought to be understood and respected by those seeking to extend the open source techniques and philosophies to other domains.

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